Operations and Travel Information Integration Sharing

Concept of Operations

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Revision History

Version	Date	Description	Description of Changes
0.1	Oct 7, 2013	Draft Concept of Operations	Initial draft
0.2	Dec 5, 2013	Draft ConOps with revisions	Steering committee revisions added

Disclaimer

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List of Abbreviations

AIAA	American Institute of Astronautics and Aeronautics
ANSI	American Nationals Standards Institute
ATA	American Trucking Associations
ATIS	Advanced Traveler Information System
CCTV	Closed Circuit Television
CVO	Commercial Vehicle Operator
DOT	Department of Transportation
FTE	Full-Time Equivalent
ITS	Intelligent Transportation Systems
MCOM	Multi-state Corridor Operations Management
NOAA	National Oceanic and Atmospheric Administration
N/WP	North/West Passage
OTIIS	Operations and Travel Information Integration Sharing
RWIS	Road Weather Information System
WTI	Western Transportation Institute

Executive Summary

The North/West Passage (N/WP) corridor follows I-90 and I-94 from Washington to Wisconsin through eight states and nearly 2000 miles. These two interstate highways comprise a major east-west corridor for commercial and recreational travel passing through Washington, Idaho, Montana, Wyoming, North Dakota, South Dakota, Minnesota and Wisconsin. This effort will develop a traveler information platform to assist planning of long-distance trips, collecting and housing operational data, and understanding methods to modify driver behavior. The emphasis of the Operations and Travel Information Integration Sharing (OTIIS) Project is to provide traveler information on the eight state corridor-wide scale.

A primary objective of this project is to identify features for a corridor-wide system and to provide traveler information across state boundaries for the long distance traveler. This document is the second in a series, and presents, in broad terms, the proposed corridor-wide traveler information systems concept of operations.

Technical Memorandum No. 1 reported current trends in traveler information and technology through a literature review and closer look at current systems. A Steering Committee survey was also performed and input was obtained to help determine the desired information layers for the system.

The selected layers are Road Work Information, Incident/Crash Information, Road Condition Information, Weather Information, Road Closure Information, Temporary Restrictions Information, Mountain Pass Information, Historic Crash Trend Information, Road Weather Information System (RWIS) Information, Camera Image Information, Congestion Information, Truck Stop Information, Fuel Station Information, Rest Area Information, Recreation Interests Information, Travel Time Comparisons w/ Alternate Routes, and Truck Parking Information.

The corridor-wide traveler information system will benefit the Commercial Vehicle Operator (CVO) and recreational traveler by improving access to critical multistate traveler information for route and safety decisions. It will also improve travel enjoyment by providing targeted information for both groups. The corridor-wide website will be easily accessed by both desktop and mobile devices.

The corridor-wide traveler information system is needed to improve multistate CVO and recreational traveler safety and decision making. The corridor-wide website server will initially be located at the Western Transportation Institute (WTI).

This report addresses the system's overall conceptual operations as well as options and limitations, management issues, and personnel considerations required for the real time corridor-wide traveler information system, named the *NWP Road to Safe Discovery* Advanced Traveler Information.

The next step, after this document is accepted, is completion of the System Requirements document. The System Requirements document details the corridor-wide system's design, identifies equipment alternatives and training needed, and describes required documentation.

1 PURPOSE OF DOCUMENT

This chapter describes the purpose of this document and defines a concept of operations.

1.1 Purpose

The purpose of this document is to present the N/WP stakeholders with a concept of operations for the proposed corridor-wide traveler information system that will provide expanded information for the CVO and recreational traveler, continuity with state Department of Transportation (DOT) traveler information websites, and is optimized for mobile devices. The recommendations are based on comments and selections made by the steering committee, technical memoranda, and stakeholder meetings.

1.2 What is a Concept of Operations?

A concept of operations is a document that describes the high-level capabilities of a specific system to a broad audience. Traditionally, the document answers six questions: who, what, when, where, why, and how.

In North/West Passage's case:

- Who:

  Who are the internal and external stakeholders? Who will be impacted by, and might benefit from, traveler information across the corridor?

- What:

  What is the high-level functionality of the system? This section also pinpoints issues that need to be addressed and details corridor-wide website features.

- When:

  What is the timeline for deploying the system?

- Where:

  Where will the server be located, and which locations will be covered by the traveler information system?

- Why:

  Why is the system needed, and how will the CVO and multistate traveler benefit from the system?

- How:

  This section helps identify the resources needed to successfully implement the corridor-wide traveler information system — particularly the data sources, mobile device access, management issues, resources, etc.

Figure 1 provides a graphical flow of the information and questions that the concept of operations addresses.

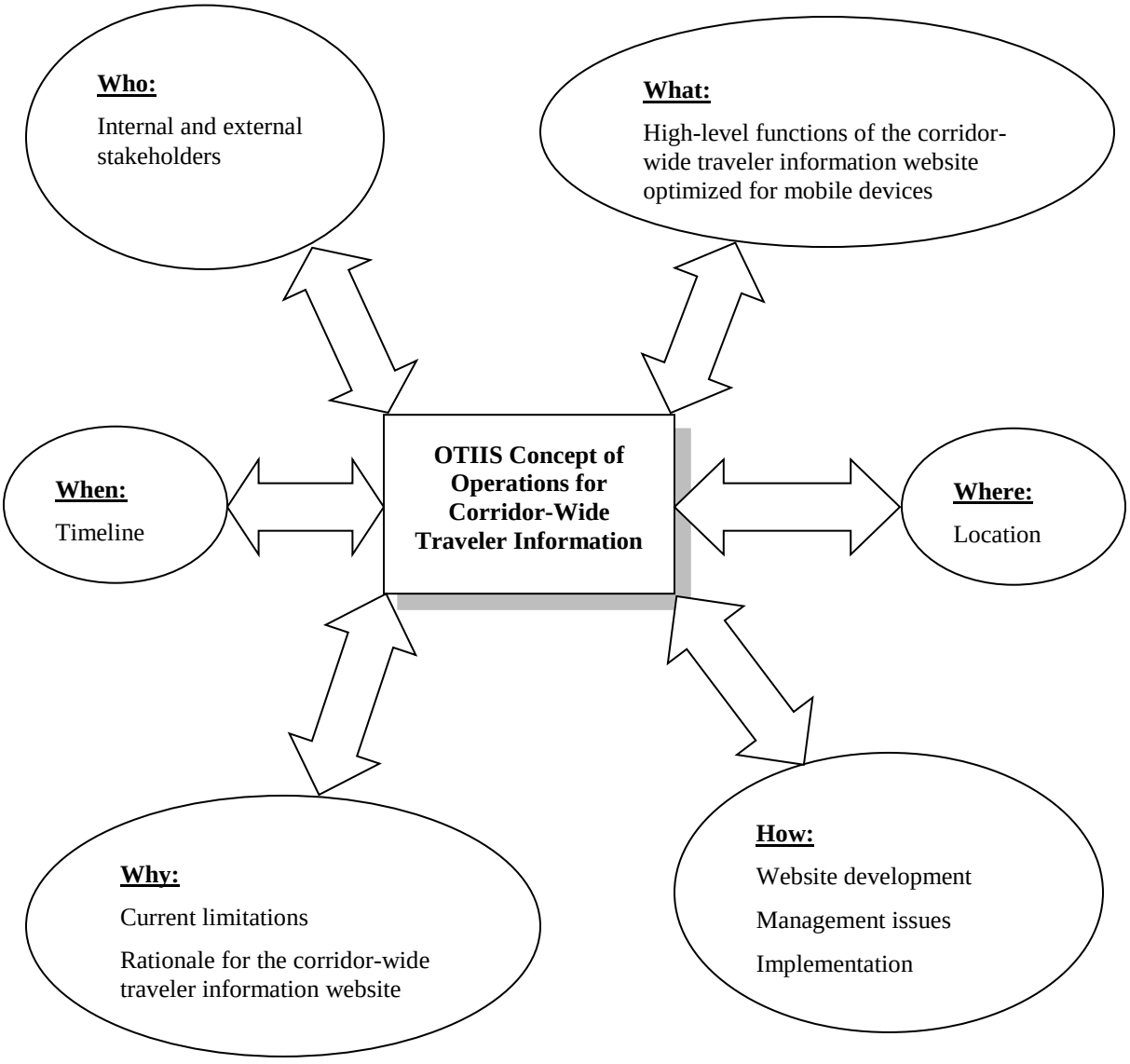

Figure 1: Questions Addressed by the Concept of Operations

The concept of operations is a customized document that addresses the individual needs of the system/organization in broad terms [Smith, 2005]. It should outline the scope of system functionality in very general terms as opposed to providing specific details about system functionality. The process of developing a concept of operations is often iterative. New iterations pinpoint functions performed by the system and help refine the scope of what the system will do.

1.3 What a Concept of Operations is Not

A concept of operations is not a document that details the specifics of how a system will work. It is not a requirements analysis, operations manual, or a one-size-fits-all approach to defining system functionality [Smith, 2005]. The document will not provide low-level technical detail

about how the overall system will work. It should not be mistaken for any of these types of technical documents.

1.4 Major Goals of a Concept of Operations

There are four major goals associated with a concept of operations [Smith, 2005]:

- Stakeholder identification and communication: One of the primary goals of a concept of operations is to identify and initiate communications with the stakeholders. The concept of operations should provide a non-technical, high-level definition of the system and its abilities. The document should enable the stakeholders to understand what the system is capable of doing, and the issues that the system is intended to address.
- High-level system definition: The purpose of the concept of operation is to outline the capabilities of the system in high-level, non-technical terms so that the stakeholders understand the basic functionality of the system. It will outline basic operations as well as the information flow that needs to occur.
- Foundation for lower-level system description: It should be possible to use the concept of operations as the basis for a requirements document and the lower-level definition of system functionality.
- Definition of major user classes and user activities: The concept of operations should determine, for the stakeholders, exactly who would be using the system and identify the activities to be performed by the end users of the system. It basically outlines who is doing what and in what context. This is useful for traceability purposes.

1.5 Core Elements

According to the American Nationals Standards Institute (ANSI)/American Institute of Astronautics and Aeronautics (AIAA) standard, there are eight core elements to a concept of operations [Smith, 2005]:

- Scope;
- Referenced documents;
- User-oriented operational description;
- Identification of operational needs;
- System overview;
- Operational environment description;
- Support environment description; and
- Operational scenario development.

These core elements will be incorporated into the following sections and discussed as they pertain to the corridor-wide traveler information system.

The objective of this concept of operations report is to provide a high-level view of the corridor-wide traveler information system optimized for mobile devices focusing on the CVO and recreational traveler. The purpose of this document is to carefully plan and define in broad terms the system.

2 SCOPE OF PROJECT

The North/West Passage corridor follows I-90 and I-94 from Washington to Wisconsin through eight states and nearly 2000 miles. These two interstate highways comprise a major east-west corridor for commercial and recreational travel passing through Washington, Idaho, Montana, Wyoming, North Dakota, South Dakota, Minnesota and Wisconsin. Figure 2 shows the eight states and the interstates on the current North/West Passage corridor-wide traveler information website.

Figure 2: N/WP Corridor-wide Website

The current corridor-wide website provides a central site for accessing links to a limited number of state closed circuit television (CCTV) cameras and the National Weather Service weather conditions (blue dots).

The OTIIS project's website will provide improved geographical scales, target groups, communication methods, and primary functions, and increase the types of information available to the user. The OTIIS website will include detailed information for the entire corridor and a route planner. OTIIS will also target CVOs more heavily than states currently do. The OTIIS system will include new communication methods not currently used by most state DOTs, such as auditory en-route push notifications, long range pre-trip weather forecasting, and route selection / information.

The OTIIS system will convey information to the user that is not currently provided by state DOT websites, such as multi-state route information, long range weather forecasts, recreation activities planning, and unique mobile features. To develop the corridor-wide website the project will purchase a server and website development software that will initially be located at WTI.

3 REFERENCED DOCUMENTS

The following documents supported the preparation of this Concept of Operations:

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4 BACKGROUND

This section provides background information for the OTIIS corridor-wide system project. It includes current operation, user profiles, justification for change, and traveler information needs.

4.1 User Profiles

This section describes the "users," or those who would use the system. In general, the users can be grouped into the following categories: 1) CVOs; 2) Business Travelers and 3) Recreational Travelers.

For this project:

- A CVO hauls passengers or goods for a fee (usually in a larger vehicle), has a commercial driver's license, and is usually on a time-sensitive schedule.
- A business traveler is driving for meetings / sales related trips on a schedule similar to a CVO, but typically in a passenger car.
- A recreational traveler is typically traveling for pleasure often without rigid schedules and may be in a passenger car or RV.

4.2 User Needs

This section identifies specific needs, both for the travelers using the system and the NWP member states, based on past literature review and Steering Committee surveys and feedback (See Appendix 10.1).

1. Travelers on the NWP Corridor need travel information, including: road work, incidents, road weather conditions, atmospheric weather conditions and forecasts, closures, temporary truck restrictions, mounting pass information, traffic congestion, known safety problem areas, RWIS observations, camera images, and locations of truck stops, truck parking areas, fuel stations, rest areas and recreational points of interest.
2. Travelers need access to information en-route, through computers and mobile devices.
3. Travelers need urgent notifications pushed to them en-route in a manner that minimizes driver distraction.
4. Travelers need information to be personalized.
5. Travelers need information to extend beyond individual state borders so they can consider and make decisions about the entire trip. Information should consider such things as large storms that impact multiple states and road work along a multi-state route, and summarize expected delay across multiple states so the entire trip can be considered.
6. While many trips use the Interstate, they start and end at homes, local businesses and recreational attractions. Travelers need information guiding them to and from these destinations, which may be off the Interstate system.
7. NWP member states need any systems that can be developed and operated with minimal costs to the states, preferably underwritten through some form of sponsorship or advertising, and using existing data to the extent possible.
8. Travelers need systems that are accessible to drivers with vision and manual dexterity issues.

4.3 Current Operations

The N/W Passage coalition has identified and completed a number of tasks including a corridor-wide traveler information website (see Figure 2). The current corridor-wide website provides a central site for accessing links to a limited number of state CCTV cameras and weather conditions. A specific state's traveler information website may be accessed by clicking on the state's name, which brings up a view of the state. Clicking on the state name again brings up the state's website. The website is supported by the N/WP Pooled Fund with a cloud-based server running custom developed open source website software. The system is maintained by the University of Wisconsin - Madison.

Individual state DOT traveler information websites have much valuable information (closures, road work, incidents, camera images, etc.), but lack the ability to show information beyond their state borders. Some states have mobile-specific websites and/or mobile apps, but again the information provided is limited to the individual state. In general, state traveler information systems currently provide no route comparisons, travel time estimates, directions, push notifications, or information about recreational opportunities.

Travelers often utilize private sector traveler information like Google Maps, MapQuest, and mobile applications, similar to those previously discussed in Tech Memo 1. In general, these systems provide specific directions, traffic conditions, trucker specific information and unique recreation opportunities, but lack the operational data provided on state DOT systems.

4.4 Justification for Change

Considering the needs, as defined in section 4.2, and the current operations available to users, as defined in section 4.3, many NWP traveler needs are currently unmet and may be addressed in developing the OTIIS System. In order to meet these needs, the individual state DOT information needs to be aggregated and communicated ubiquitously across the corridor. This information also needs to be augmented with routing, travel times, and recreational information, as well as adding mobile functionality and personalization of the data for the user.

The system vision to meet these needs is described in the following sections. In general terms, the system would comprise a traditional traveler information website (with added routing planning functionality and customizable profiles) and a mobile system that includes en-route features like notifications, navigation, and way-finding.

4.5 Resources and Limitations

Resources that are anticipated to be used in the OTIIS System include:

1. State DOT data including road work, incidents/crashes, road weather conditions, road closures, temporary truck restrictions, mountain pass information, RWIS conditions, camera images, truck parking areas, and rest areas.
2. NOAA weather information including current and forecast atmospheric conditions and severe weather alerts.
3. Private databases (like: truckstopinfoplus.com or gasbuddy.com) for truck stop and fuel station information.
4. State tourism departments for recreational points of interest.

5. Google Maps API for mapping, routing, travel times (may also come from recently available historic data Nokia/Navteq data), and directions.
6. Potential for limited continued funding (similar to that evidenced by current corridor website).

The limitations known to exist currently include:

1. State DOT data is of differing level of detail and quality.
2. State DOT data formats are not consistent for all states.
3. Some states may provide access to only a portion of the desired data listed above.
4. Some states may not allow advertisement on the system website.
5. The operational data available off of major Interstates and Highways may be lacking.
6. No project funding to add sensors or data publishing technology in states not currently providing certain data.

5 PROPOSED SYSTEM

The proposed corridor-wide traveler information system will provide CVO, business and recreational travelers multistate coordinated travel information. The proposed system name is *NWP Road to Safe Discovery* Advanced Traveler Information. The OTIIS Systems Concepts Mockups, including scenario walkthroughs and individual layer discussions, have been presented to the Steering Committee. Appendix 10.2 has detailed feedback from the Steering Committee to be integrated in the system moving forward.

5.1 Introduction

The system will be sustained through the lowest possible operations costs offset by any possible sponsorship or advertising revenue. A detailed sustainable business model is slated for development in a future project task. The system will address as many of the needs identified in Section 4.2 as possible by utilizing the existing resources and respecting the constraints and limitations. This sustainable system will be a website and related mobile application, together with data integration that will add value to the existing data from the member states and represent corridor-wide traveler information.

5.2 Differences of the Proposed System from Existing Traveler Information Systems

The design and implementation of OTIIS represents an evolution of existing travel information systems, such as the One Stop Shop system and individual state's 511 systems. The OTIIS system, however, will offer hitherto unavailable functionality well beyond the capabilities of existing efforts. Appendix 10.3 has a detailed description of the differences.

5.3 Functional Website

The website will feature a route planner where the traveler indicates the beginning and end points of the route. A menu system will enable users to indicate the types of information they would like to see displayed on their route.

Icons will appear on the route, which when clicked on will bring up more detailed information on that topic. Further, clicking on the new information will drill down farther, bringing up more details.

The proposed website includes a route planner with a menu system to select the type of information wanted. The menu system will allow a traveler to select the types of information most important for their trip. It will initially show a 30,000 foot level overview that could be zoomed to the level of desired detail.

5.4 Website Stakeholders

This section describes the "users," or those who will interface with the system. In general, the users can be grouped into the following categories:

1) CVO,

2) Recreational Travelers,

3) State DOT personnel,

4) Data Quality Control staff, and

5) Website Maintenance staff.

The CVO category includes over-the-road truckers, regional sales people, and fleet dispatchers. They may use the website on a daily basis and make business decisions based on the website's information. Recreational travelers are tourists, traveling for pleasure typically without a rigid schedule. They're open to interesting diversions and may consider different route options. State DOT personnel provide most of the data used by the corridor website and typically manage the state's website. The corridor wide website's data quality control staff is responsible, where applicable, for checking the accuracy and timeliness of the website's information. OTIIS quality control will ensure that States' data is being translated accurately, but likely can't ensure that the States' data itself is accurate. They manage the day to day operation of the website and deal with any website issues. Website maintenance is required on a periodic basis and could be handled by a contractor.

5.5 Website Overview

This section provides an overview of the OTIIS website and its various layers. A conceptual design of the home page is shown in Figure 3.

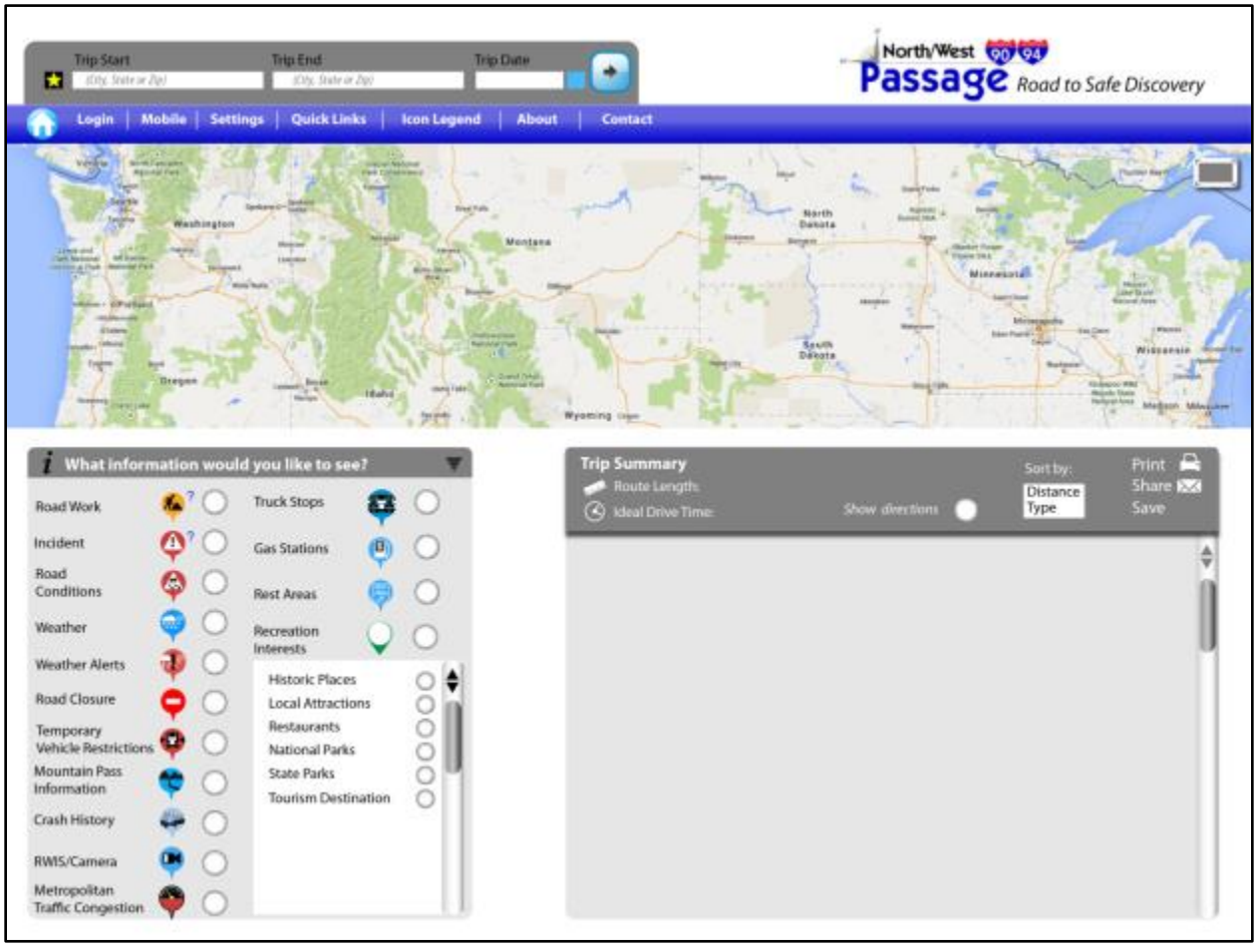


Figure 3: OTIIS Website's Concept Home Page

The homepage shows the entire corridor map along with a list of the information layers available in the menu on lower left side of the figure. A layer is selected by clicking the white circle after

the icon. After a trip's date, beginning and end locations are entered in the trip bar located above the map, a summary of the trip is shown on the lower right along with the pertinent information for the items selected in the information layer menu.

Figure 4 shows a saved route from the N/WP website accessed with a mobile device while en route. *NWP Road to Safe Discovery* Advanced Traveler Information Mobile App provides the en route access.

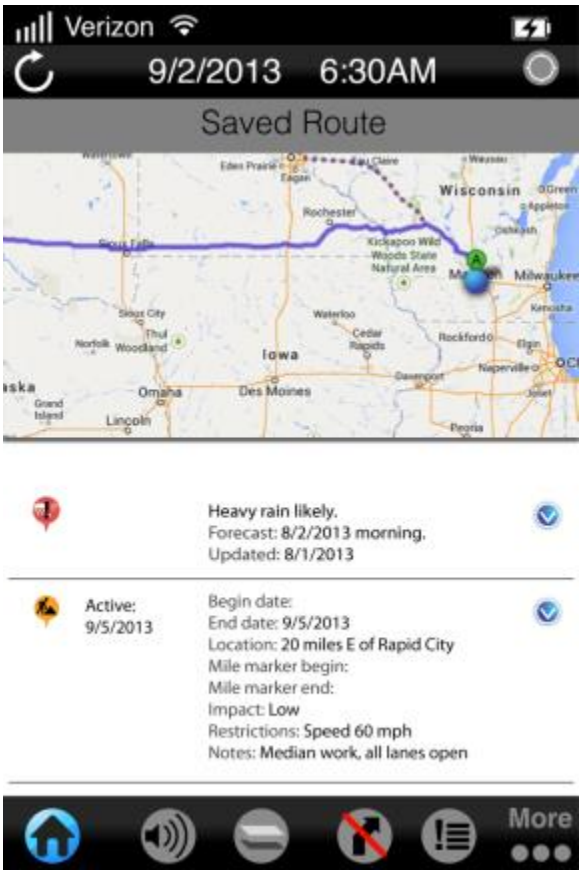


Figure 4: Website Concept on Mobile Device

See Appendices 10.4 and 10.5 for detailed scenarios based on the vision of how the website will work with mobile devices.

5.5.1 Road Work Information

Figure 5 shows a mockup of the website's road work information page. A localized map is shown with buttons showing road work locations. Clicking a button activates a popup displaying that location's road work status, begin and end dates for the road work, specific location information, expected impact, and notes describing additional relevant details.

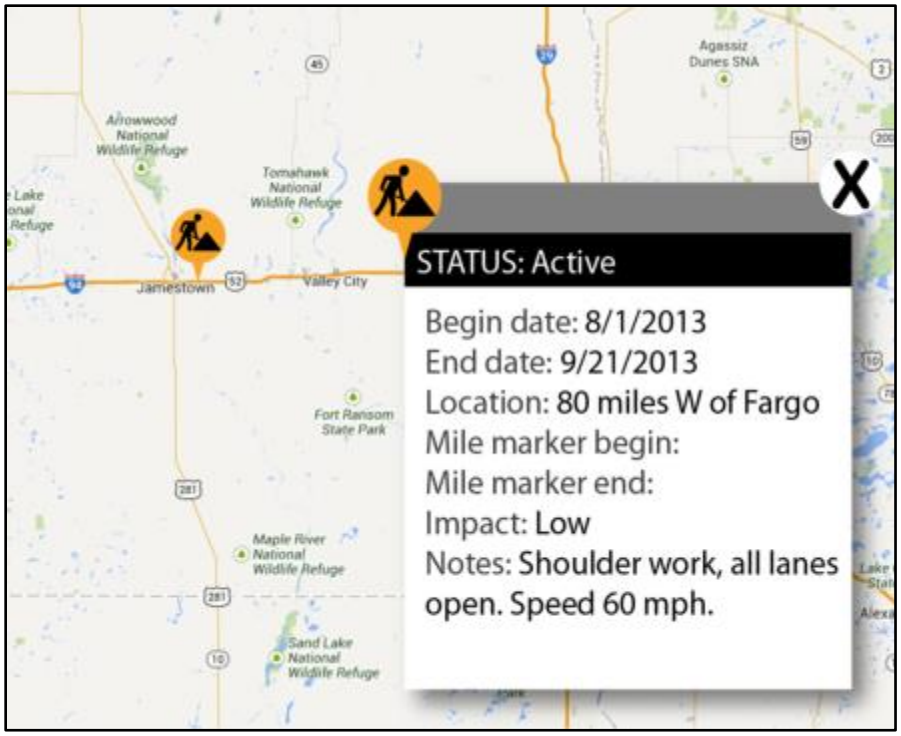


Figure 5: Road Work*[1] Information

The popup's road work data and its options are shown below:

- Status: [active or planned]
- Dates: [MM/DD/YY to MM/DD/YY]
- Location[2]: [mile posts] or [XX miles west of TOWN NAME]
- Notes: [resurfacing, striping, etc.] and [delays, restrictions, detours, etc.]
- Impact: [low, medium, high]

[1] * indicates naming determined by NWP Project 3.1.

[2] Location descriptions either by mile post or town/area vicinity are proposed as a possibility and may or may not be possible for all states and/or all types of information.

5.5.2 Incident/Crash Information

Shown in Figure 6 is a mockup of the website's incident information page. A localized map is shown with a button indicating a crash. Clicking the button activates a popup displaying the incident information's date and time stamp along with the location, description and travel impact of the incident.

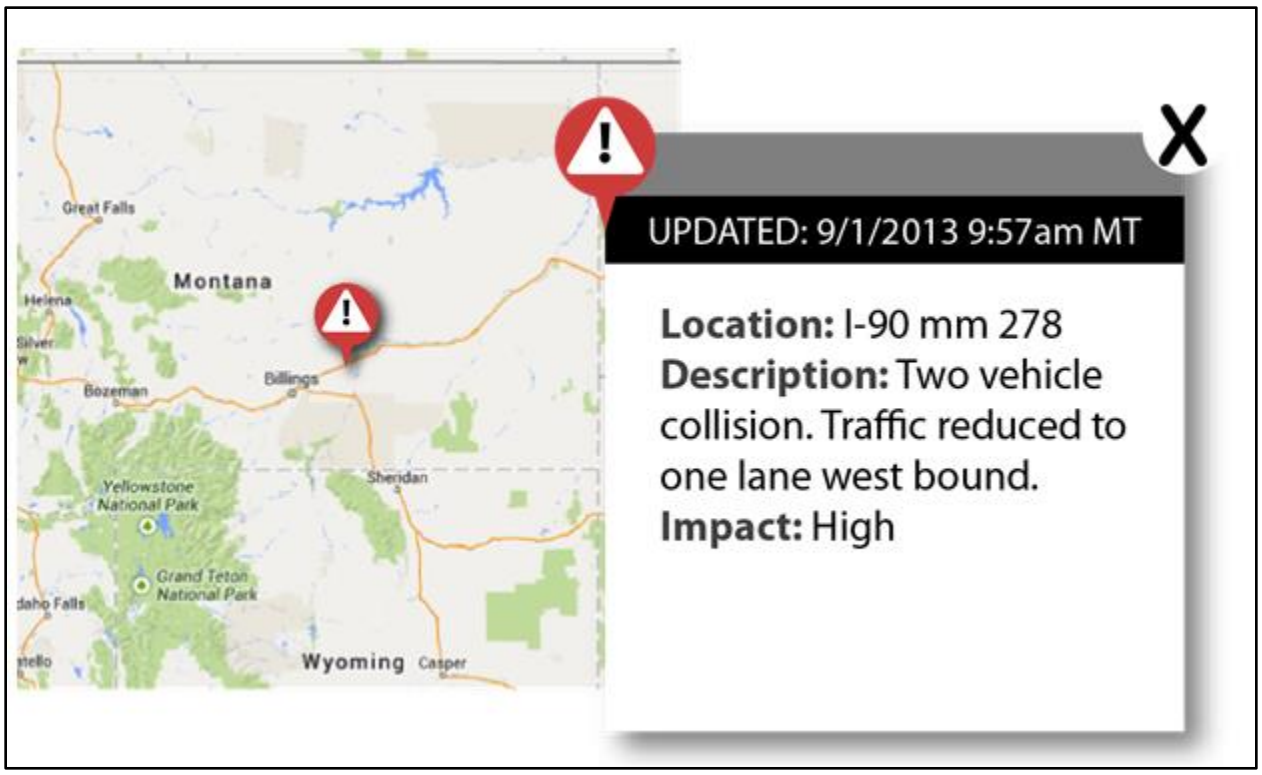


Figure 6: Incident*/Crash* Information

The popup's incident data and its options are shown below:

- Date: [MM/DD/YY]
- Time: [HH:MM]
- Location: [mile posts] or [XX miles west of TOWN NAME]
- Description: [multi-vehicle collision, stalled vehicle, stopped traffic, etc.] and [lane blocked, traffic reduced to one lane westbound, etc.]
- Impact: [low, medium, high]

5.5.3 Road Condition Information

A mockup of the website's road condition information page is shown in Figure 7. A localized map is shown with buttons indicating adverse condition locations. Selecting a button activates a popup with the details of that location's road conditions. The popup shows the information's date and time stamp along with the location, description, and condition.

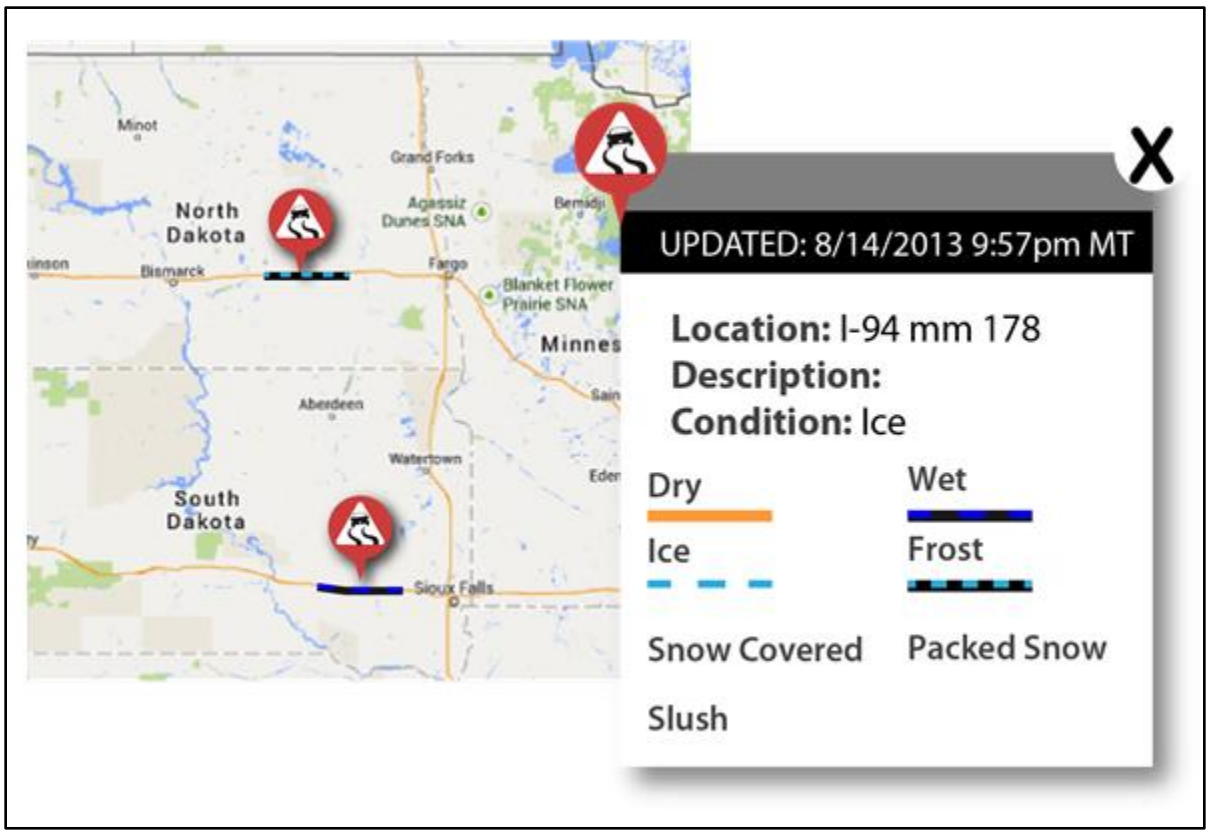


Figure 7: Road Condition Information

The popup's road condition data and its options are shown below:

- Date: [MM/DD/YY]
- Time: [HH:MM]
- Location: [mile posts] or [XX miles west of TOWN NAME]
- Conditions: [dry*, wet*, snow covered*, packed snow*, ice*, frost*, slush*]

5.5.4 Weather Information

Shown in Figure 8 is a mockup of the website's weather information page. A localized map is displayed with buttons indicating available information. Clicking a button activates a popup of the selected area's current weather and forecast. A popup of a weather alert for the same area is also shown. Only condition, forecast and alert data applicable to the selected location is displayed.

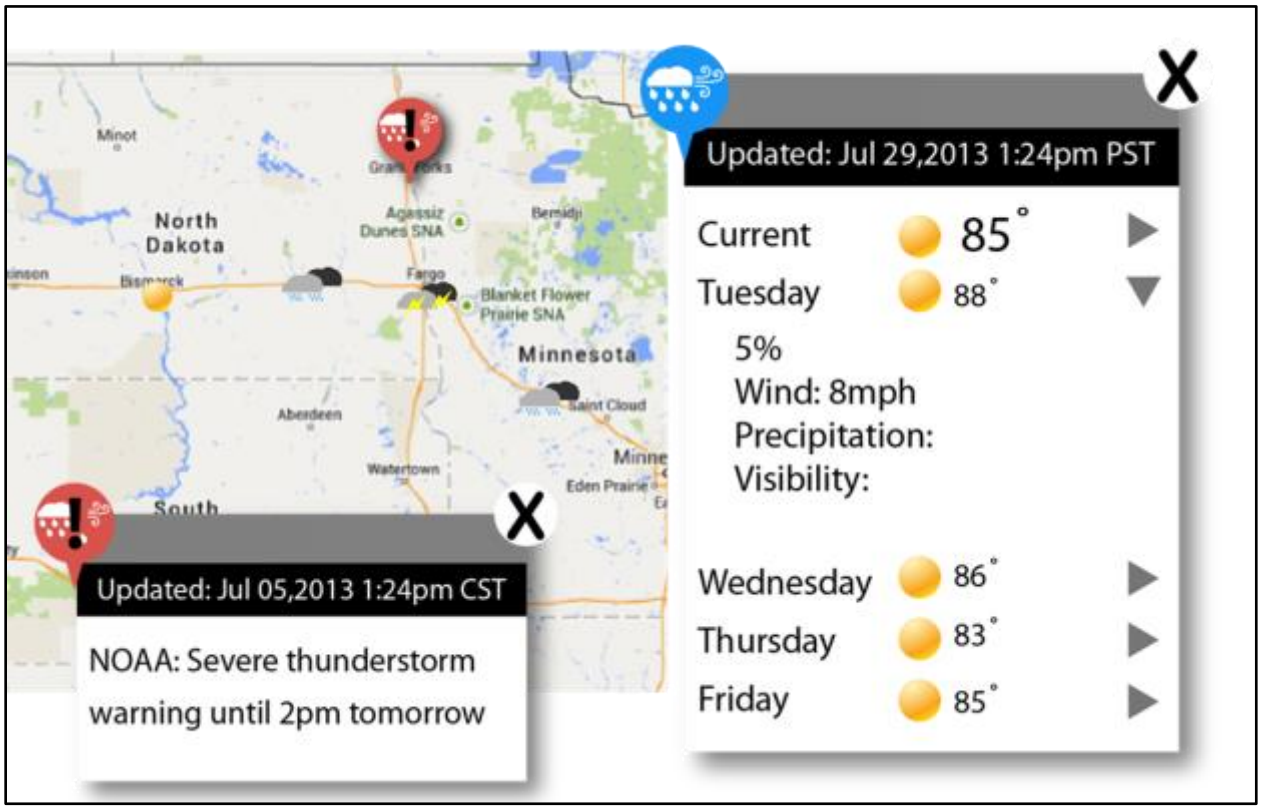


Figure 8: Weather Information

The popup's weather data, alerts and their options are shown below:

- Date: [MM/DD/YY]
- Time: [HH:MM]
- Location: [town, city, area name]
- Conditions: [sunny, partly cloudy, rain*, freezing rain*, snow*, blowing snow*, drifting snow*, reduced visibility*, strong wind*]
- Forecast: [today, tomorrow, etc.] and [details within day: hourly or AM/PM etc.]
- Alert: [severe thunderstorm warning, tornado watch, flash flood warning, +]

The alert data is ingested from the National Oceanic and Atmospheric Administration (NOAA). A comprehensive list for NOAA alerts can be found at http://www.nws.noaa.gov/wwamap-prd/faq.php.

5.5.5 Road Closure Information

A mockup of the website's road closure information page is shown in Figure 9. A localized map is shown with a button indicating a road closure. Clicking the button activates a popup displaying the closure information's date and time stamp along with the location, description and duration of the closure.

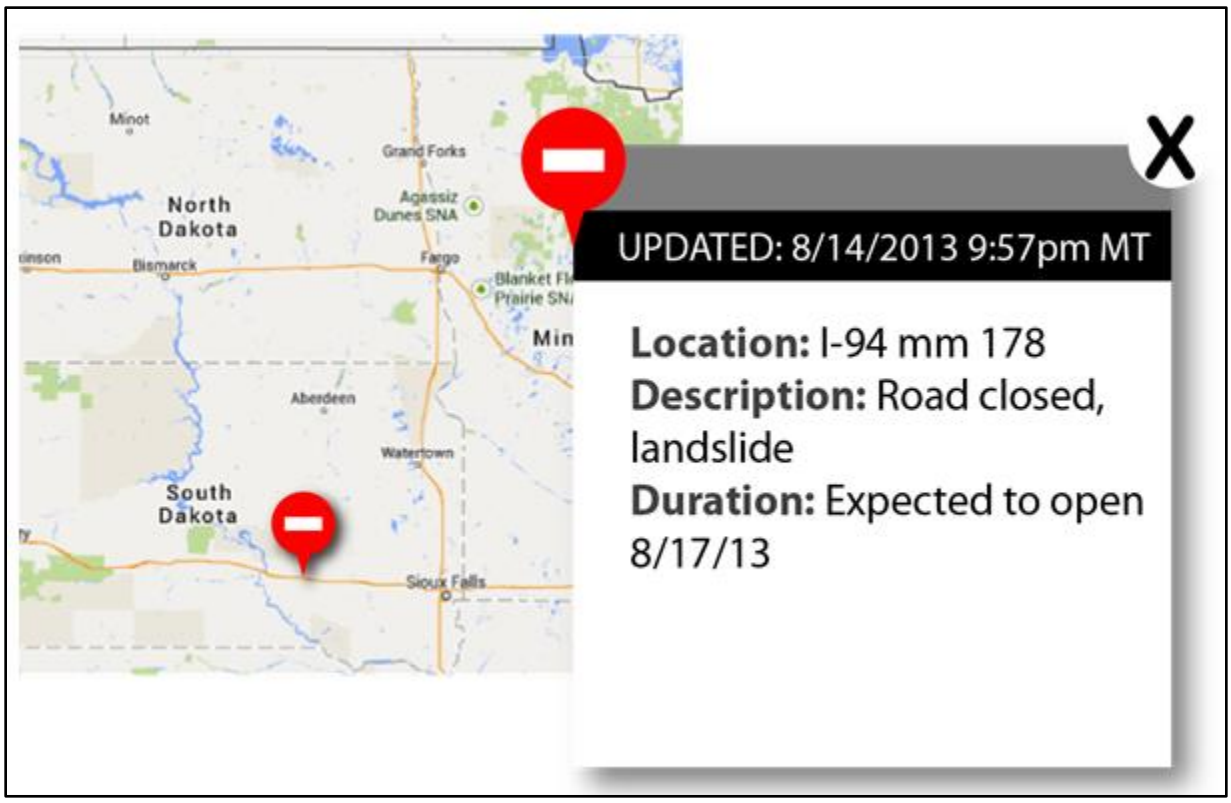


Figure 9: Road Closure* Information

The popup's road closure data and its options are shown below:

- Date: [MM/DD/YY]
- Time: [HH:MM]
- Location: [mile posts] or [XX miles west of TOWN NAME]
- Description: [road closed*, road blocked*, lane blocked*, landslide, seasonal closure, etc.]
- Duration: [X hours or X days or until X]

5.5.6 Temporary Restrictions Information

Figure 10 shows a mockup of the website's temporary restriction information page. A localized map is shown with a button indicating the location of the restriction. Clicking the button displays a popup showing the restriction's status and its beginning and end date along with a description of its location and the restriction.

Figure 10: Temporary Restrictions Information

The popup's temporary road restriction data and its options are shown below.

- Status: [active or planned]
- Dates: [MM/DD/YY to MM/DD/YY]
- Location: [mile posts] or [XX miles west of TOWN NAME]
- Description: [width limit ##*, height limit ##*, weight limit ##*, length limit ##*, chains required]

5.5.7 Mountain Pass Information

Shown in Figure 11 is a mockup of the website's mountain pass information page. A zoomed map displays the mountain pass' location and buttons to show the weather forecast, RWIS and camera, if applicable.

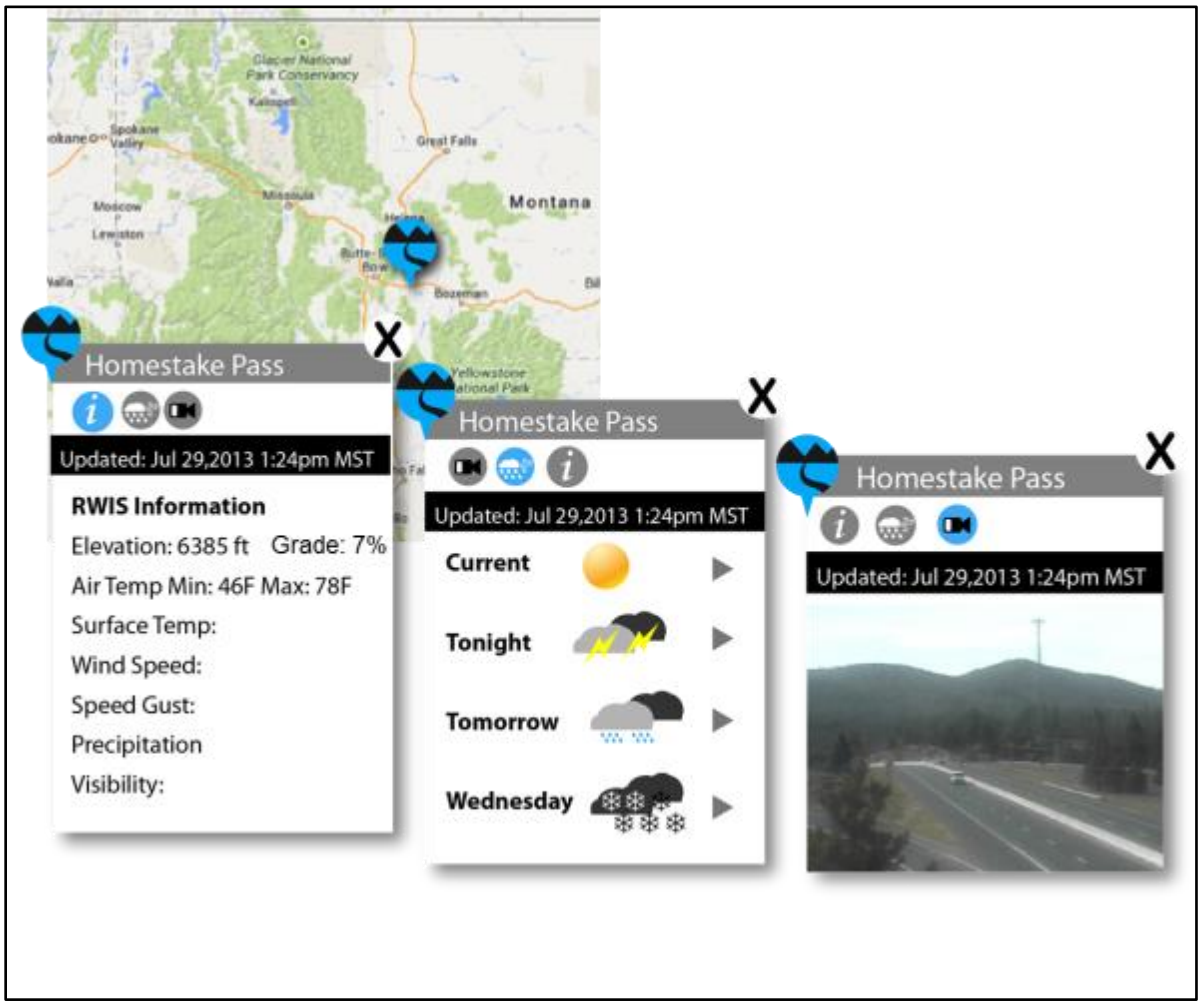


Figure 11: Mountain Pass Information

The popup's mountain pass data and its options are shown below:

- Date: [MM/DD/YY]
- Time: [HH:MM]
- Location: [pass name]
- Max Grade: [XX%]
- Elevation: [XXXX ft]
- Camera: [button to show camera view if applicable]
- RWIS: [button to show RWIS data if applicable (temp., wind, precipitation, etc.)]
- Weather Forecast: [button to show weather and forecast weather for that location]

5.5.8 Cautionary Zone Information

Figure 12 shows a mockup of the website's cautionary zone information page. A localized map is shown with buttons showing cautionary zone locations. Clicking a button activates a popup displaying the location, date and time the information was updated, and a short description of the type of zone. A limited number of cautionary zones will be proposed by WTI initially and the State's will be included in the validation of these zones. The ability for each state to self-report cautionary zones will be included in the system development.

Figure 12: Cautionary Zone Information

The popup's historic crash data and its options are shown below:

- Location: [mile posts] or [XX miles west of TOWN NAME]
- Description: [high deer-vehicle collision location, high involvement of large-truck in collisions, high winter-weather related crash location, etc.]

5.5.9 RWIS Information

A mockup of the website's RWIS information page is shown in Figure 13. A localized map is shown with a button indicating an RWIS site. Clicking the button activates a popup displaying the RWIS location and the information's date and time stamp, along with the site's elevation, air temperature, surface temperature, wind speed and visibility.

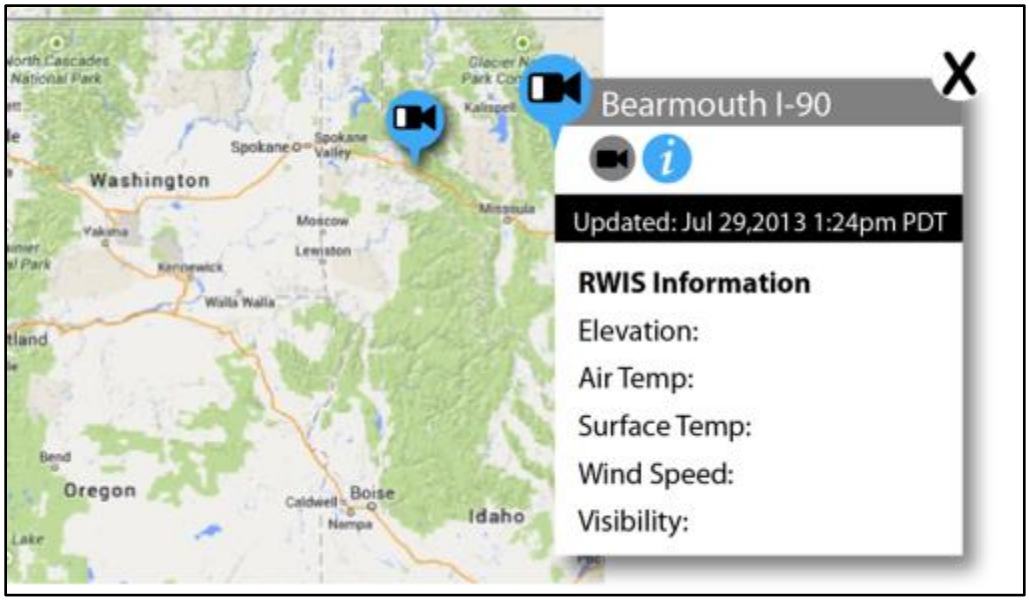


Figure 13: RWIS Information

The popup's RWIS data and its options are shown below:

- Date: [MM/DD/YY]
- Time: [HH:MM]
- Location: [mile posts] or [area name]
- RWIS: [RWIS data if applicable (temp., humidity, wind, precipitation, etc.)]

5.5.10 DMS Information

Shown in Figure 16 is a mockup of the website's DMS information page. A localized map is shown with a button indicating a DMS location. Clicking the button activates a popup displaying the DMS's location, the information's date and time stamp along with the message, if applicable.

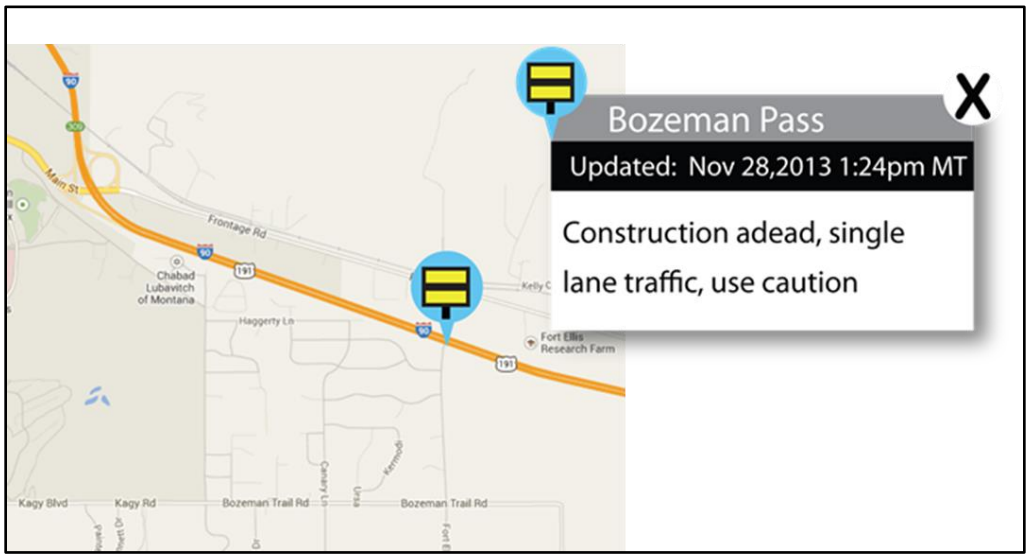


Figure 14: DMS Information

The popup's DMS data and its options are shown below:

- Date: [MM/DD/YY]
- Time: [HH:MM]
- Location: [mile posts] or [area name]
- DMS: [DMS message if available]

5.5.11 Weigh Station Information

Figure 15 shows a mockup of the website's weigh station information page. A localized map is shown with a button indicating a weigh station location. Clicking the button activates a popup displaying the weigh station's location and status, if available, and the information's date and time stamp.

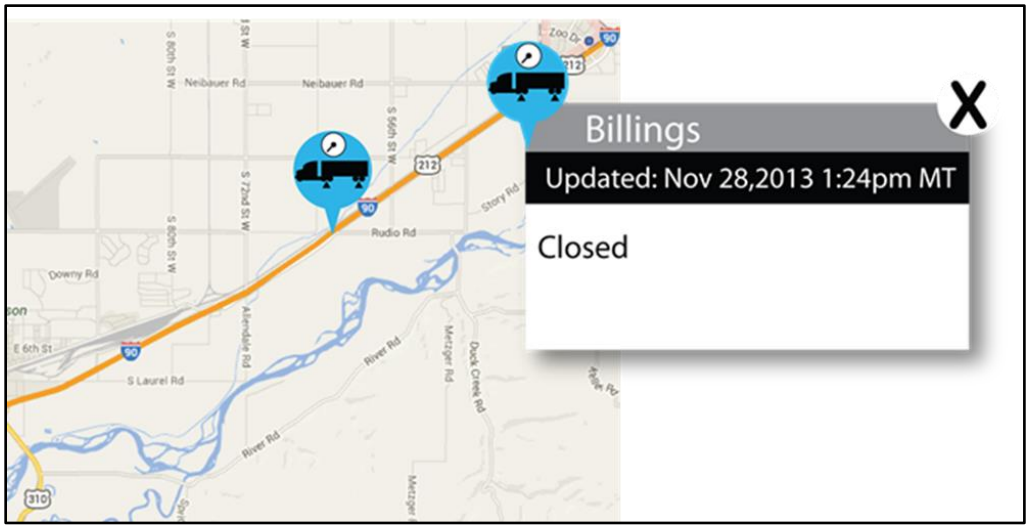


Figure 15: Weigh Station Information

The popup's weigh station data and its options are shown below:

- Date: [MM/DD/YY]
- Time: [HH:MM]
- Location: [mile posts] or [area name]
- Status: [open or closed, bypass system active, etc. (if available)]

5.5.12 Camera Image Information

Shown in Figure 16 is a mockup of the website's camera information page. A localized map is shown with a button indicating a camera location. Clicking the button activates a popup displaying the camera's location, image date and time stamp along with the image.

Figure 16: Camera Information

The popup's camera data and its options are shown below:

- Date: [MM/DD/YY]
- Time: [HH:MM]
- Location: [mile posts] or [area name]
- Camera: [camera view if applicable]

5.5.13 Traffic Congestion Information

A mockup of the website's congestion information page is shown in Figure 17. A localized map is shown with a button indicating the location of the congestion. Clicking the button displays a popup showing the congestion's location with a date and time stamp, along with a description of the severity of the congestion.

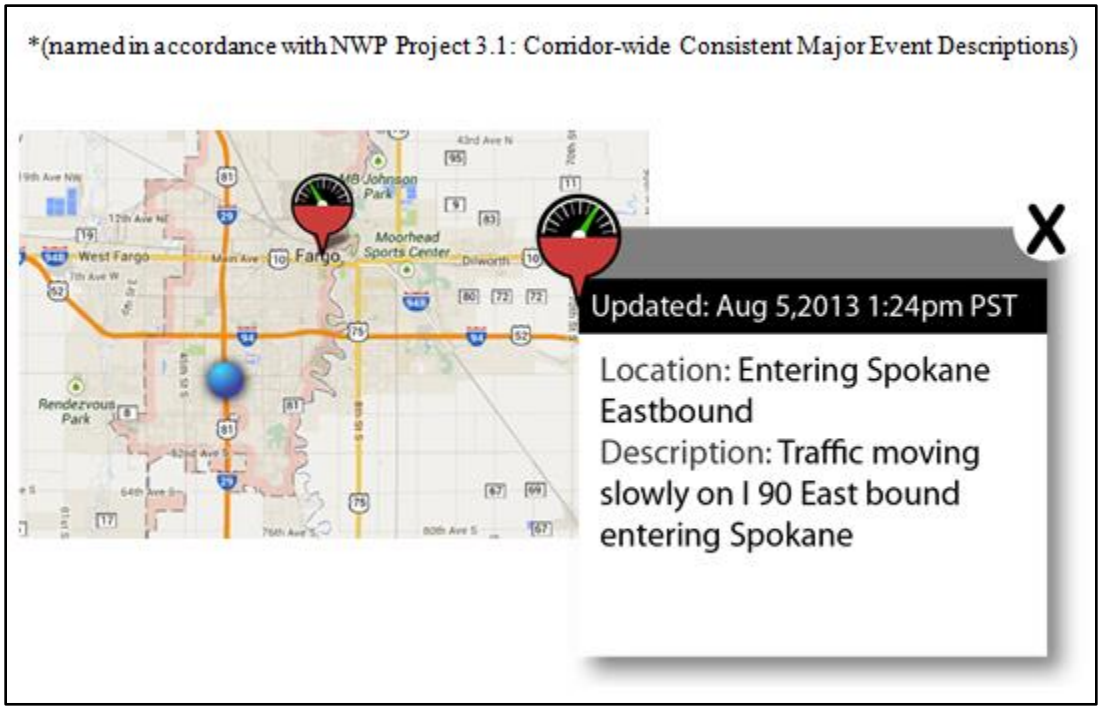


Figure 17: Traffic Congestion* Information

The popup's congestion data and its options are shown below:

- Date: [MM/DD/YY]
- Time: [HH:MM]
- Location: [mile posts] or [entering TOWN NAME westbound, etc.]
- Description: [traffic moving slowly entering Spokane eastbound]

5.5.14 Truck Stop Information

Shown in Figure 18 is a mockup of the website's truck stop information page. A localized map is shown with buttons indicating truck stop locations. Selecting a button activates a popup that displays the details of the truck stop. The popup shows the location, name, amenities and truck parking info.

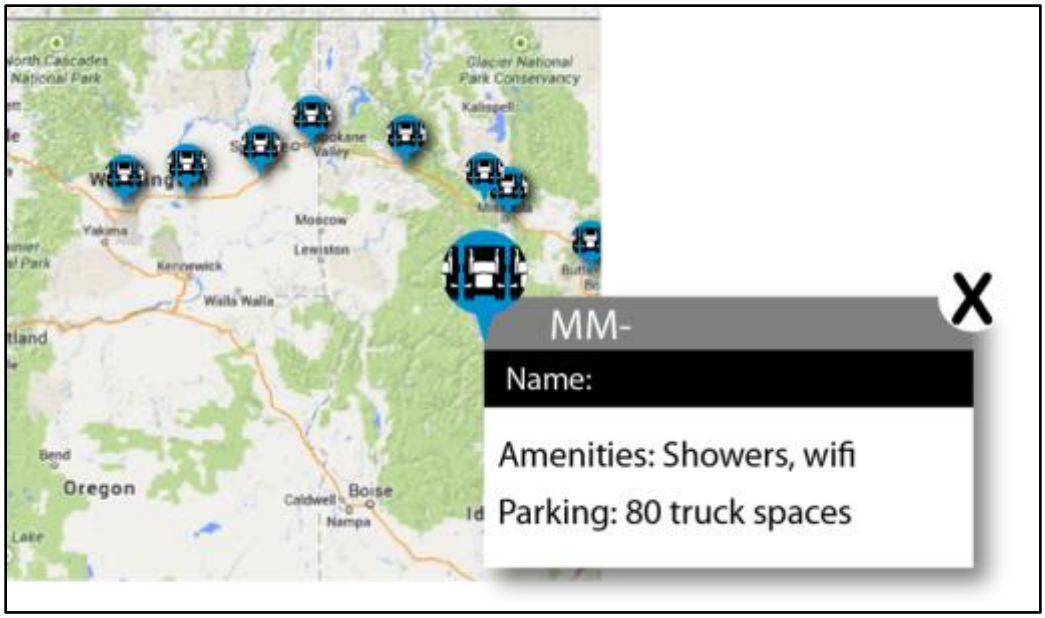


Figure 18: Truck Stop Information

The popup's truck stop data and its options are shown below:

- Location: [mile posts] or [town/area name]
- Name: [Carters, etc.]
- Amenities: [showers, restaurant, etc.]
- Parking: [## truck spaces] or [S, M, L]

5.5.15 Fuel Station Information

Figure 19 shows a mockup of the website's fuel station information page. A localized map is shown with buttons indicating fuel station locations. Selecting a button activates a popup with the location, name of the fuel station, and any amenities.

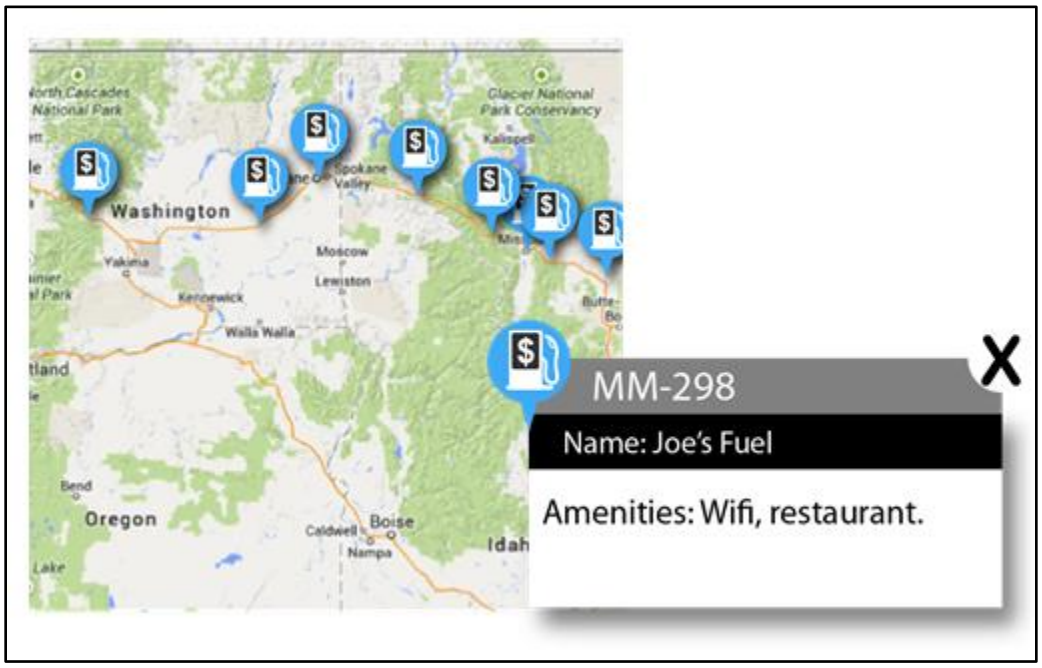


Figure 19: Fuel Station Information

The popup's fuel station data and its options are shown below:

- Location: [mile posts] or [town/area name]
- Station Name: [Joe's Fuel, etc.]
- Amenities: [WiFi, restaurant, convenience store]

5.5.16 Rest Area Information

A mockup of the website's rest area information page is shown in Figure 20. A localized map is shown with buttons indicating rest area locations. Selecting a button activates a popup with the location, name, amenities and truck parking availability.

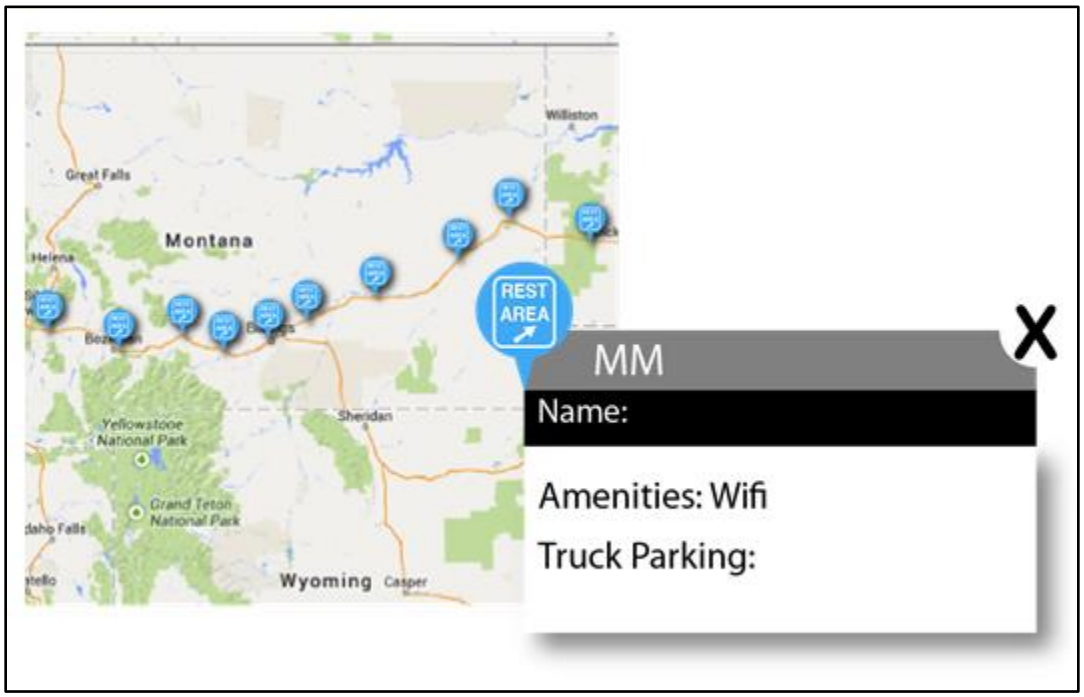


Figure 20: Rest Area Information

The popup's rest area data and its options are shown below:

- Location: [mile posts] or [town/area name]
- Amenities: [WiFi, heated restrooms, etc.]
- Truck Parking: [Yes/No] and [## spaces (if available)]

5.5.17 Recreation Interests Information

Figure 21 shows a mockup of the website's recreation interests information page. A route map is shown with buttons indicating recreation locations. Selecting a button activates a popup with the type, name, location, additional distance, additional drive time, description and a website link.

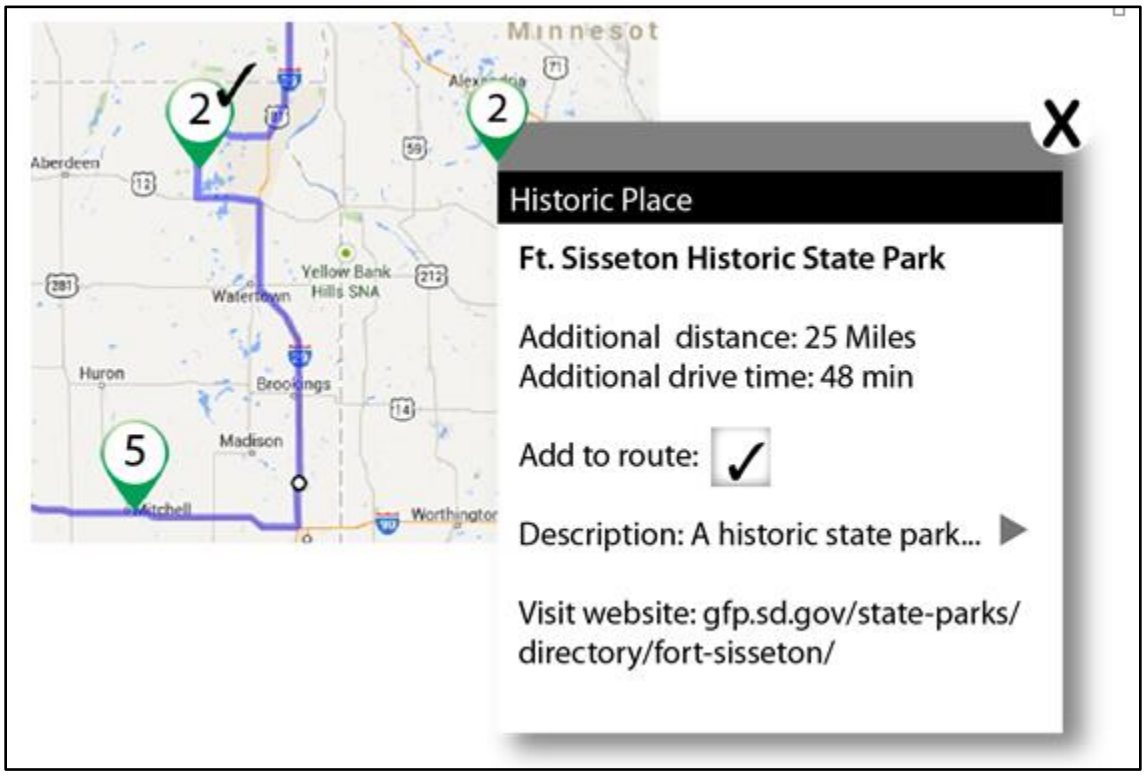


Figure 21: Recreation Interests Information

The popup's recreation interests data and its options are shown below:

- Name: [Ft. Sisseton Historic State Park]
- Location: [mile posts] or [town/area name]
- Additional Distance: [XX miles]
- Additional Time: [XX hrs XX min]
- Description: [A historic state park that …]
- Link to Website: [http://gfp.sd.gov/state-parks/directory/fort-sisseton/ if available]

5.5.18 Travel Time Comparisons w/ Alternate Routes

Figure 22 shows a mockup of the website's travel time with alternate routes information page. A map is shown with the routes shown in different colors and buttons enabling selection of a route. The popups indicate the distance and expected travel time for each route.

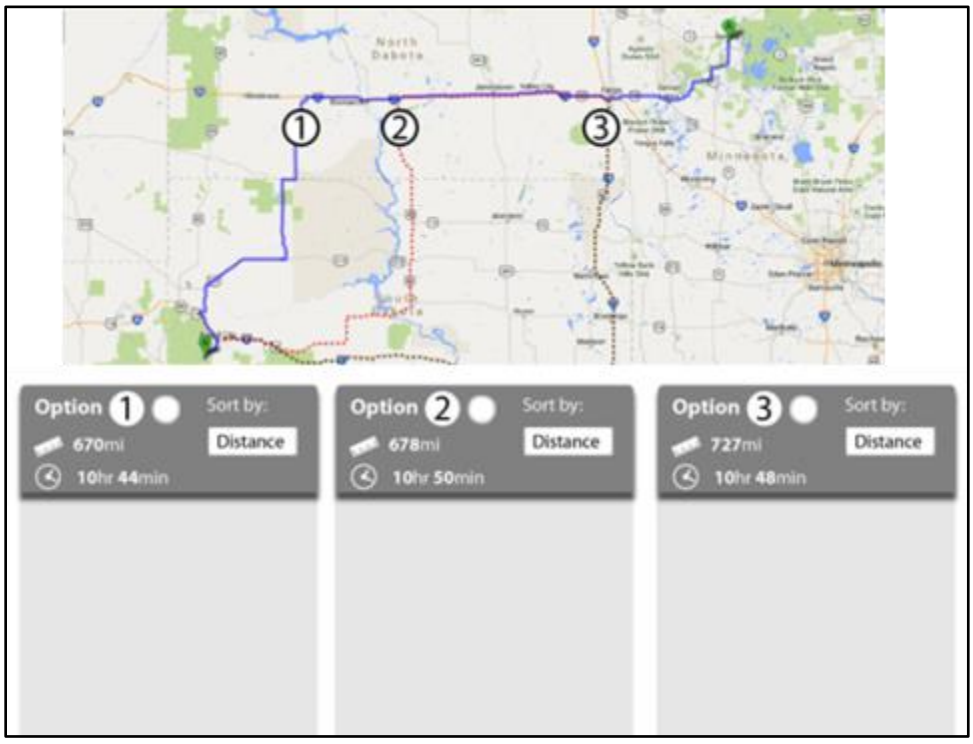


Figure 22: Travel Time Information

5.5.19 Truck Parking Information

A mockup of the website's truck parking information page is shown in Figure 23. A localized map is shown with buttons indicating truck parking locations. Clicking a button activates a popup displaying the location, name, amenities and number of truck parking spaces.

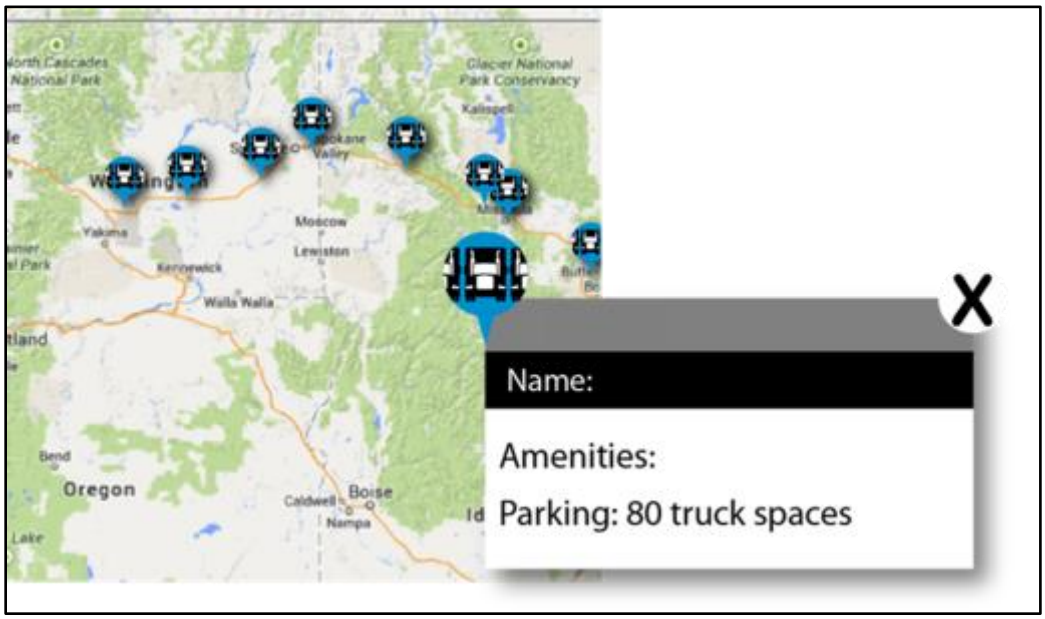


Figure 23: Truck Parking Information

The popup's truck parking data and its options are shown below:

- Location: [mile posts] or [town/area name]
- Amenities: [toilet, Wi-Fi, etc.]
- Parking: [## truck spaces] or [S, M, L]

6 SUPPORT ENVIRONMENT

This section describes the current and planned physical support environment. This includes facilities, equipment, computing hardware, software, personnel, operational procedures, and maintenance. This includes expected support from outside agencies.

6.1 Computing Hardware

The website will be hosted on a server at a location with power outage support equipment that will keep the server operational 24/7 in the event of a grid outage.

6.2 Software

The intention is to use open source software for the server and website creation. The exception is the use of Google Maps API. Server software is the server's operating system. Website development software runs on the server. The software will require operational and maintenance support. Operational support involves checking the data's accuracy and timeliness, where applicable, before it is posted to the website and responding to website crashes and trouble reports (i.e. dealing with day to day issues). Maintenance support is required to update the server, website software and mobile apps, typically on a fixed schedule.

6.3 Personnel

The website will be supported by data quality control personnel and website maintenance personnel. Emergency response for the website will be provided from 8AM to 5PM week days. Operational support may be optimized for expected high traffic periods such as holidays, storm events, etc.

Operational support staff will likely need training to provide data quality control. If website maintenance is contracted to an outside vendor, training would not be expected.

A website trial period will include the first four to six months of operation after the final website design has been approved and the website deployed. This trial period will provide time for establishing better estimates of hosting and operational support requirements.

A rough estimate for operations and maintenance cost currently includes a 0.25 to 0.50 FTE personnel for staffing purposes. This estimate will be improved upon during the trial period once the challenges are better understood. The major factor that could be expected to increase operations costs is the changing of state provided data formats and access procedures. During the trial deployment, WTI asks that if states change their data formats or how they provide the data, the states contact WTI 1 to 2 week prior to the change if possible to allow for changes to the software to ensure a smooth transition. Depending on the size and scale of the data changes, WTI may be able to evaluate if minor changes could fall within the estimated 0.25 – 0.50 FTE responsibilities or are much larger software alterations.

6.4 Non-State DOT Data Sources

Non-state DOT data sources are expected to be used for weather forecasts, fuel stations, truck stops, tourist attractions, recreational activities, and other non-DOT website information. Quality non-fee based data sources will be given preference.

Weather forecasts are expected to be obtained from NOAA.

6.5 Institutional Arrangements

State DOTs will provide access to their data feeds (XML, FTP, Database access, etc.) necessary to implement the OTIIS database i.e. the N/WP website; the OTIIS database will not scrape data from a state's website (HTML). Missing data will be identified as such on the N/WP website. If an entire state's data is inaccessible, the deployment of the N/WP website will commence as planned with the available N/WP states data. A disclaimer to users about the missing/inaccessible state's data will be included on the website.

If the N/WP website detects faulty data or large scale failures the website will default to a static screen and provide links to individual member state's traveler information websites.

Future project tasks will investigate each state's legal ability and willingness to allow sponsorship on the N/WP system and any concerns with and definition of open-source software.

7 OPERATIONAL SCENARIOS

This section describes two example operational scenarios (construction and adverse weather) that will likely occur during OTIIS ATIS operation. For each scenario, a potential or likely experience is described for each of the user groups. For a more detailed illustration of the system operation see Appendices 10.4 and 10.5.

7.1 Situation: Construction

A new road work project has been started on I-94 in North Dakota near Bismarck. This project is deemed high impact and has a width restriction in effect requiring vehicles over 12 feet in width to use an alternate route.

7.1.1 User Experience: State DOT

North Dakota DOT personnel inform the appropriate DOT staff of the project. The DOT staff person posts the current and planned construction information (location, duration, impact, restrictions, description, etc.) to the DOT traveler information website and data feeds/formats, from which OTIIS obtains DOT data.

7.1.2 User Experience: N/WP OTIIS ATIS

The system ingests the construction information into the OTIIS database. The information is stored in the database for use on the traveler information website and mobile apps.

7.1.3 User Experience: CVO Pre-Trip

Two truckers are planning trips using the N/WP website and see the road work information. Trucker A is traveling from Madison, Wisconsin to Spokane, Washington and therefore has the option to take I-90 and miss the road work in North Dakota. Trucker B is in Fargo, North Dakota destined for Dickinson, ND. Trucker B has no viable alternate route and therefore he plans his trip to encounter the road work zone in the evening when delays may be minimal.

7.1.4 User Experience: CVO En-Route

A trucker en-route near the construction project receives an auditory alert on a smart phone. The trucker is now more aware of the upcoming conditions and can plan for the likely delay.

7.1.5 User Experience: Recreational Traveler Pre-Trip

A recreational traveler planning a trip using the N/WP website sees the road work information and considers taking other routes, perhaps with scenic byways or recreational opportunities, to bypass the affected area.

7.1.6 User Experience: Recreational Traveler En-Route

A recreational traveler en-route near the construction project receives an auditory alert on a smart phone. The traveler is now more aware of the upcoming conditions and can plan for the likely delay.

7.2 Situation: Adverse Weather

A winter storm is moving eastbound across much of Northern Wyoming and Southeastern Montana, including portions of I-90.

7.2.1 User Experience: State DOT

Wyoming and Montana DOT personnel monitor weather sensors deployed in the field and receive updates via telephone and email from winter maintenance workers and citizen reporters. The information is then posted to the Wyoming and Montana traveler information websites.

7.2.2 User Experience: NWP OTIIS ATIS

The system ingests the weather information (road conditions map, wind speed map, radar imagery, mountain pass weather, and camera images/video) from the DOTs and/or primary weather sources. The forecast weather information is ingested from the national weather service as well. All weather information is collected and stored in the OTIIS database for use on the traveler information website and mobile app.

7.2.3 User Experience: CVO Pre-Trip

A trucking company dispatcher is planning trips for their drivers using the N/WP website. One driver is going to be traveling from Sioux Falls, South Dakota to Butte, Montana. The dispatcher sees the severe weather information forecast and tells the driver to delay the trip for one day to experience better road conditions.

7.2.4 User Experience: CVO En-Route

A trucking company dispatcher is monitoring the conditions along the corridor for a driver en-route. The dispatcher is then able to radio the driver en-route that is nearing the severe weather. The trucker is now aware of the upcoming conditions and can plan to park for the night while the storm dissipates.

7.2.5 User Experience: Recreational Traveler Pre-Trip

A recreational traveler planning a trip home from Rapid City, South Dakota to Billings, Montana is using the N/WP website and sees the severe weather forecast information. The traveler decides to extend his stay visiting his family to wait for more favorable traveling conditions.

7.2.6 User Experience: Recreational Traveler En-Route

A recreational traveler en-route near the severe weather location receives an auditory alert on a smart phone. The traveler is now aware of the upcoming conditions and calls his family to inform them that he will likely be late arriving to their planned event due to the adverse driving conditions.

8 ROLES FOR WEBSITE DEVELOPMENT

The operational scenarios presented in the previous section have identified several activities that will need to be addressed for the OTIIS website. This section identifies those roles.

Table 1: Roles for Website Development

Needed Activities	Roles and Considerations
Systems Engineering Analysis	
Develop a traveler needs assessment. Complete a steering committee requirements survey. Develop a ConOps. Develop system requirements.	WTI will develop a traveler needs assessment, steering committee requirements survey, ConOps, System Requirements. N/WP steering committee will review and provide feedback.
Software Development	
Develop server software for database. Develop mobile apps for iOS and Android	WTI will develop the software based on prior steps. N/WP states will provide access to state data feeds (XML, FTP, direct database access, *NOT* HTML). N/WP states will provide a 1-2 week notice to WTI, if possible, prior to data format or feed changes.
Operation of the System	
Determine host server location. Provide operational support. Provide maintenance support. Identify operational funding for the website.	WTI will host, operate and maintain the system similarly to how a state does their own website, for the agreed upon timeline. N/WP steering committee will review and provide feedback.
Future Expansion	
Identify funding for future expansion.	WTI will identify future funding (other than NWP states alone) and pursue phase 2 federal funds if possible. N/WP states will determine if OTIIS should be funded at some level by NWP/your state.

9 SUMMARY AND NEXT STEPS

This Concept of Operations has described at a high-level the proposed corridor-wide traveler information system. The corridor-wide traveler information system will benefit the CVO and recreational traveler by improving access to critical multistate traveler information for route and safety decisions. It will also improve travel enjoyment by providing targeted information for both groups. The corridor-wide website can be easily accessed by both desktop and mobile devices.

The corridor-wide server will be initially located at WTI.

The corridor-wide traveler information system is needed to improve multistate CVO and recreational traveler safety and decision making.

This report addresses the options and limitations, management issues, and personnel considerations required for the real time corridor-wide traveler information system named the *NWP Road to Safe Discovery* Advanced Traveler Information.

The next step in the process is to request review and approval of this document and the concepts presented herein by relevant stakeholders. Subsequent revision and refinement are anticipated to incorporate stakeholder input.

After this document is accepted, the next step is completion of the system architecture and requirements documents.

10 APPENDICES

10.1 Steering Committee Surveys and Recreational Traveler Desired Information

In order to determine what types of information to include in the OTIIS system, a survey of the N/WP Steering Committee members was completed as well as reviewing literature from other sources. The Steering Committee survey asked respondents to rank the importance of various types of traveler information as it pertained to CVOs pre-trip, CVOs en-route, recreational travelers pre-trip and recreational travelers en-route. The following charts show the results of the survey. These results come from seven respondents representing six N/WP states. The bar chart shows the average rating (as bar height) and the controversial symbol is shown for attributes that received at least one "not at all important" and at least one "very important" ranking (indicating the highest possible level of disagreement between respondents).

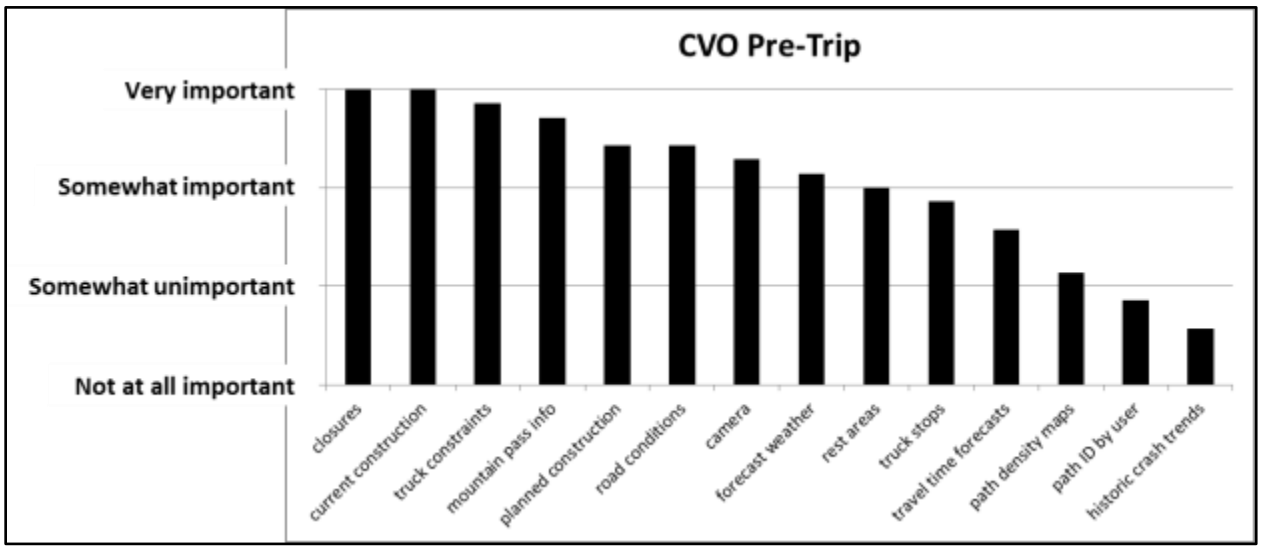


Figure 24: CVO Pre-Trip Survey Results

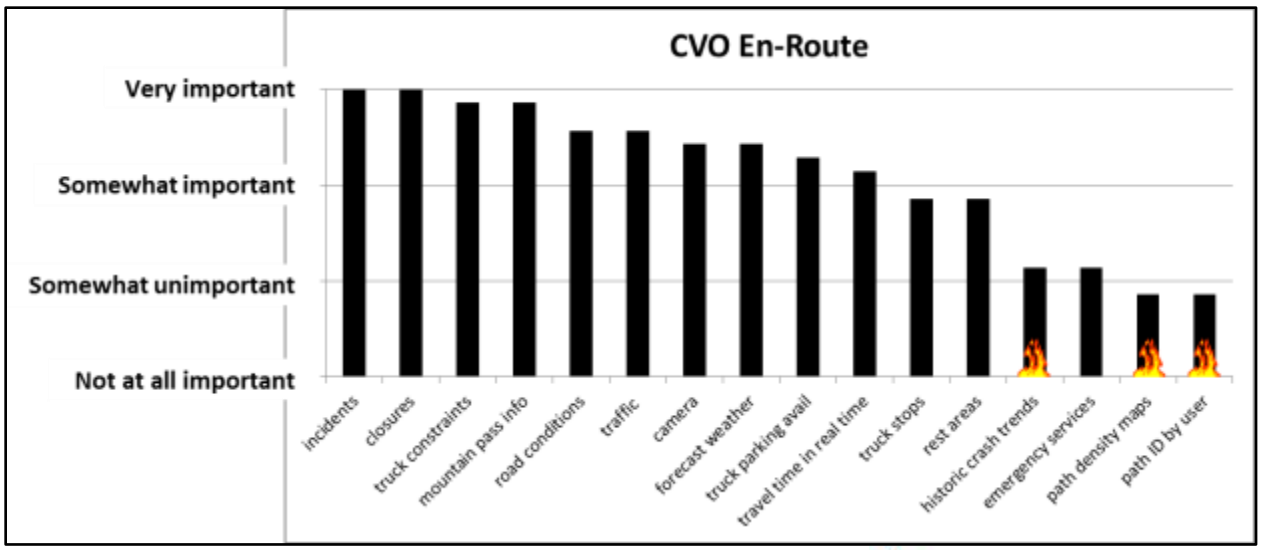


Figure 25: CVO En Route Survey Results

Highly Controversial

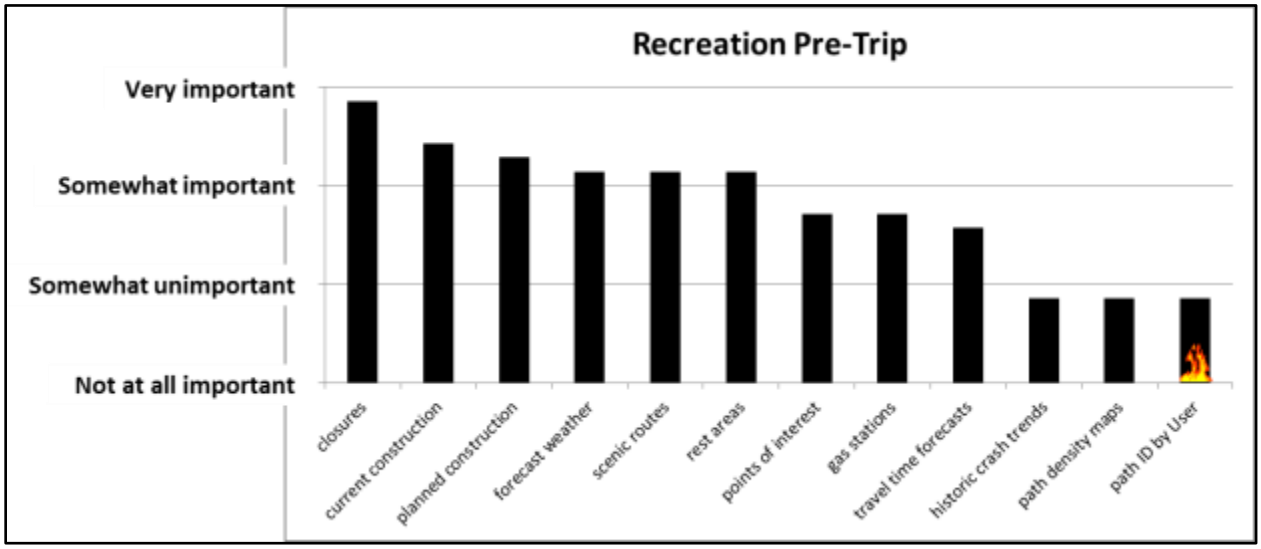


Figure 26: Recreational Traveler Pre-Trip Survey Results

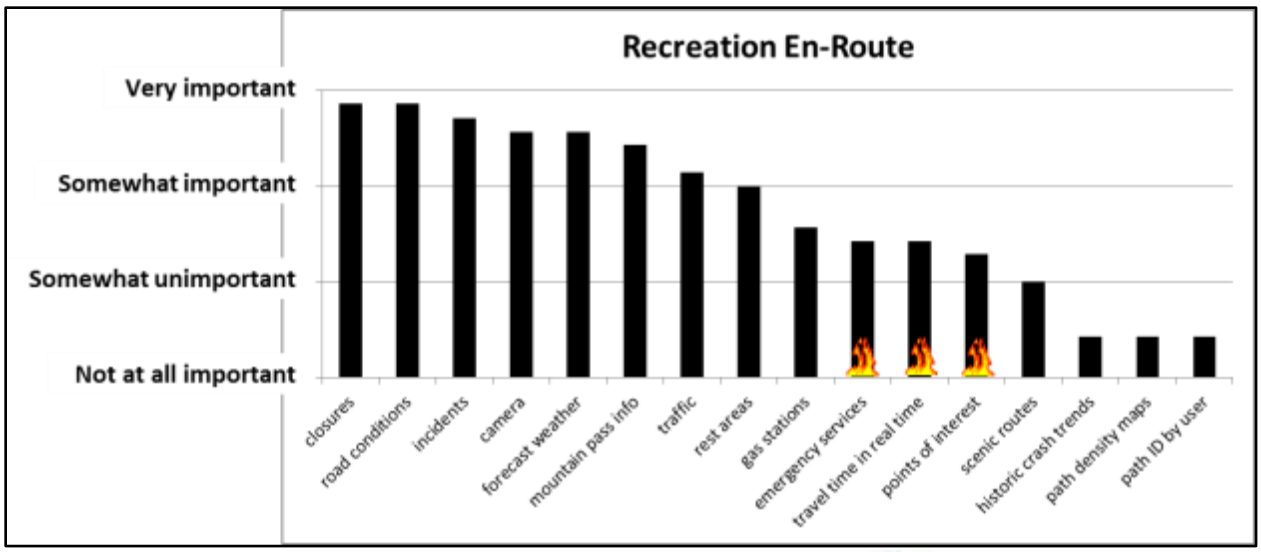


Figure 27: Recreational Traveler En Route Survey Results Highly Controversial

New literature reviewed (beyond that which was included in Tech Memo 1) also resulted in some findings that influenced the system concepts. One example that highlights the recreational traveler type literature comes from a survey completed at rest areas in Texas (Carson et al., 2011). The respondents were asked to rank the importance of certain amenities. Table 2 shows the results with traveler information type amenities highlighted.

Table 2: Traveler Amenities Survey Results

Amenity	Rating
Sufficient restroom stalls	2.77
Free wireless internet access	2.77
Sufficient passenger car and truck/RV parking	2.75
Overnight parking	2.63
Separate passenger car and truck/RV parking	2.57
Security/surveillance cameras	2.54
Weather/road/traffic condition information	2.44
Tornado shelter	2.31
Air-conditioning / heating	2.29
Beverage/snack vending machines	2.23
Building/shelter architecture and design	2.19
Grounds/landscaping	2.19

Gas/food/lodging information	2.13
Interpretive displays of local history/interests	2.13
Free Texas maps	2.06
Tourism event/attraction information	2.01
Walking/interpretive trails	1.99
Group picnic facility	1.94
Family/assisted use restrooms	1.88
"Welcome to Texas" photo opportunity	1.80
Video theater on Texas attractions	1.74
Newspaper vending machines	1.69
On-site professional travel counselor	1.68
Motor carrier permits/toll tags for purchase	1.66
Playground equipment	1.65
Diaper changing stations	1.53

Scale: 1 = not at all important, 2 = somewhat important, 3 = very important

Highlights = Traveler Information Related

This shows that recreational travelers desire not only weather, road and traffic condition information, but also gas, food, lodging, local interests and attractions.

Another example highlighting recreational travelers' information desires comes from a presentation at the ITS Heartland Conference in March 2013 (Fritsch, 2013). The presenter communicated the company's experience developing and operating kiosks and traveler information systems across the US. The company's data for the past 5 years showed that travelers use their systems to find out about certain things in rural and entering urban areas as shown in Table 3:

Table 3: Traveler Selections at Kiosks

Rural Areas	Coming into Cities
1. Weather	1. Weather
2. Tourism	2. Traffic
3. Exit Points of Interest	3. Tourism
4. Location-Based Ads	4. Location-Based Ads
5. Traffic	5. Exit Points of Interest
6. All others negligible	6. All others negligible

10.2 Suggested Improvements and Considerations from Mockups Meetings

The following table shows the "action item" type comments made by the Steering Committee about the proposed OTIIS ATIS Mockups and the action recommended by WTI to address the comments (M = make change, or C = consult committee).

	Comment(s)	Rec.
System Layers	Make RWIS / Cameras two separate layers.	M
	Use "Fuel Stations" instead of "Gas Stations".	M
	Include diesel fuel availability, or lack thereof, at fuel stations.	M
	Add DMS displays as a layer.	M
	Add "Truck Parking Areas" (different than rest areas and truck stops).	M
	Add ability to show video of truck stops to see live parking situation.	M
	Add toilets as an optional amenity to rest areas and truck parking areas.	M
	Some important buttons (incidents, closures, severe weather) may be pre-selected as a default and these may also be seasonal.	M
	Color code the layers by importance and organize accordingly.	M
	Add link to individual state DOT (perhaps in quick links tab).	M
	Include a "data unavailable" message for missing data (entire state outage, feed failure, smaller roadway class with no sensor, etc.).	M
	Add link to individual state DOT traveler information in every popup block.	C
	Rename "historically high crash location" layer "Cautionary Zones" and include known problem safety areas (roads with many curves, high winds common, etc.), animal migration areas or crossing zones, fog prone areas, especially low clearance structures.	C
System Routing and Travel Times	General weather information should be added into list for printed route information.	M
	Do not use any recommendation in routing only provide route "options".	M
	Routes off of interstate system may be grey or look different to imply that less is known operationally about these routes.	M
	Add departure time of day enabling better forecast weather across entire route.	M
	Change the ideal travel time to estimated travel time and include delays (road work, congestion, etc.).	M
	Add an option to input layover points (locations for extended stops) and 2nd day departure time of day for better route information.	M

	Comment(s)	Rec.
System in General	Misspellings in origin/destination should be expected and handled similar to Google's "did you mean:_____"	M
	Include ability to customize the quick select toolbar and/or speak commands on mobile devices.	M
	The system should allow for adding/altering buttons easily after website launch.	M
	Consider dispatchers as a major user for CVOs.	M
	Anticipate differing data and data quality from each state and be prepared to work with "least common denominator" type approach to some buttons.	M
	Prepare a desired XML type feed for each button and cross check with state's data.	M
	Recreational type information needs to match existing sources for that information like kiosks and state website(s).	M
	Include only larger recreational "generator" type attractions.	M
	Long term Google may stop allowing us use of their API – do we have other options?	C
Project	Concentrate on Interstates now and expand to lesser roads as feasible.	M
	Could get feedback from trucker directly (via ATA or similar).	M
	Investigate advertisement and linking to advertisement issues that state(s) may have.	C
	Create a NWP "Data Subcommittee" to help with accessing data and institutional arrangements.	C

The following table shows comments made that reflect changes that may be too ambitious for the current system prototype. These changes are therefore proposed for a future phase II.

	Comment(s)
Proposed for Phase II	Add forecast weather radar layer (perhaps a three day future forecast animation).
	Add forecast road conditions layer.
	Forecast and suggest possible layover points (especially CVO based on hours of drive time allowed).
	Route away from known safety problem areas (non-Interstates only).
	Consider crowdsourcing and traveler reporting of data (incidents, traffic, animals, etc.).
	Add truck permitting information to the system.

10.3 Differences between the Proposed OTIIS System and Existing Traveler Information Systems

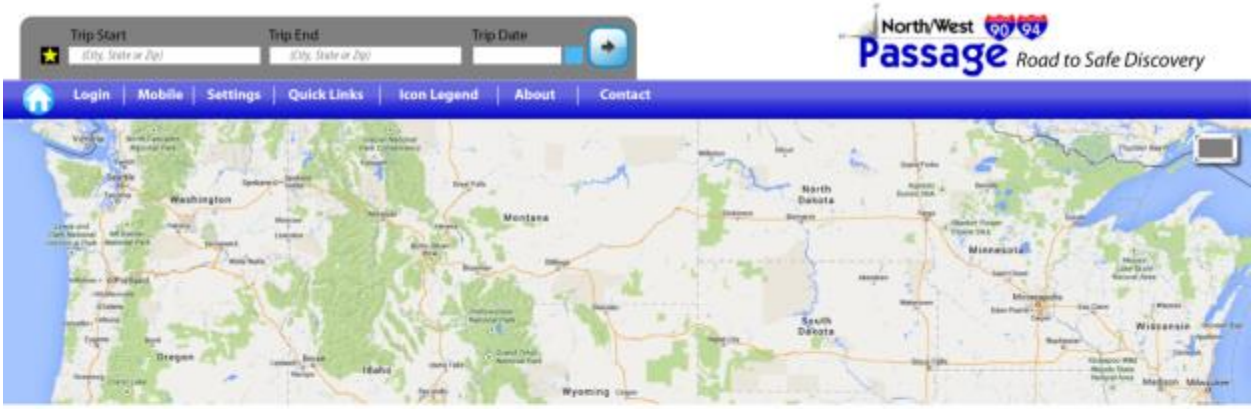
- OTIIS allows users to save and access their routes from different devices.
- OTIIS integrates data from different states and allows trip planning on a larger scale.
- OTIIS allows users to compare routes and make decisions based on travel times, forecast weather and conditions, road work, and recreational opportunities.
- OTIIS can make the integrated data available to third parties, possibly for a fee used to support the system operation. The availability of the OTIIS data can be a building block for other types of services.
- OTIIS can allow the collection of anonymized road usage information to be reported back to the states. The states can also use this information with resource planning and maintenance tasks.
- OTIIS pushes notifications to users.

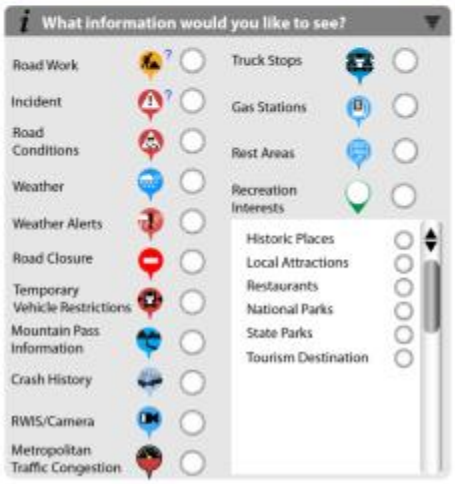
10.4 Trucker Scenario Walkthrough

Sunday (9/1/13) 9:00AM

A truck driver based in Madison, WI gets an email from his company dispatch telling him that a load is ready for delivery to Gardiner, MT and is scheduled for departure tomorrow morning.

Shortly after receiving this email, the trucker uses his desktop computer to access the new *NWP Road to Safe Discovery* Advanced Traveler Information Portal.

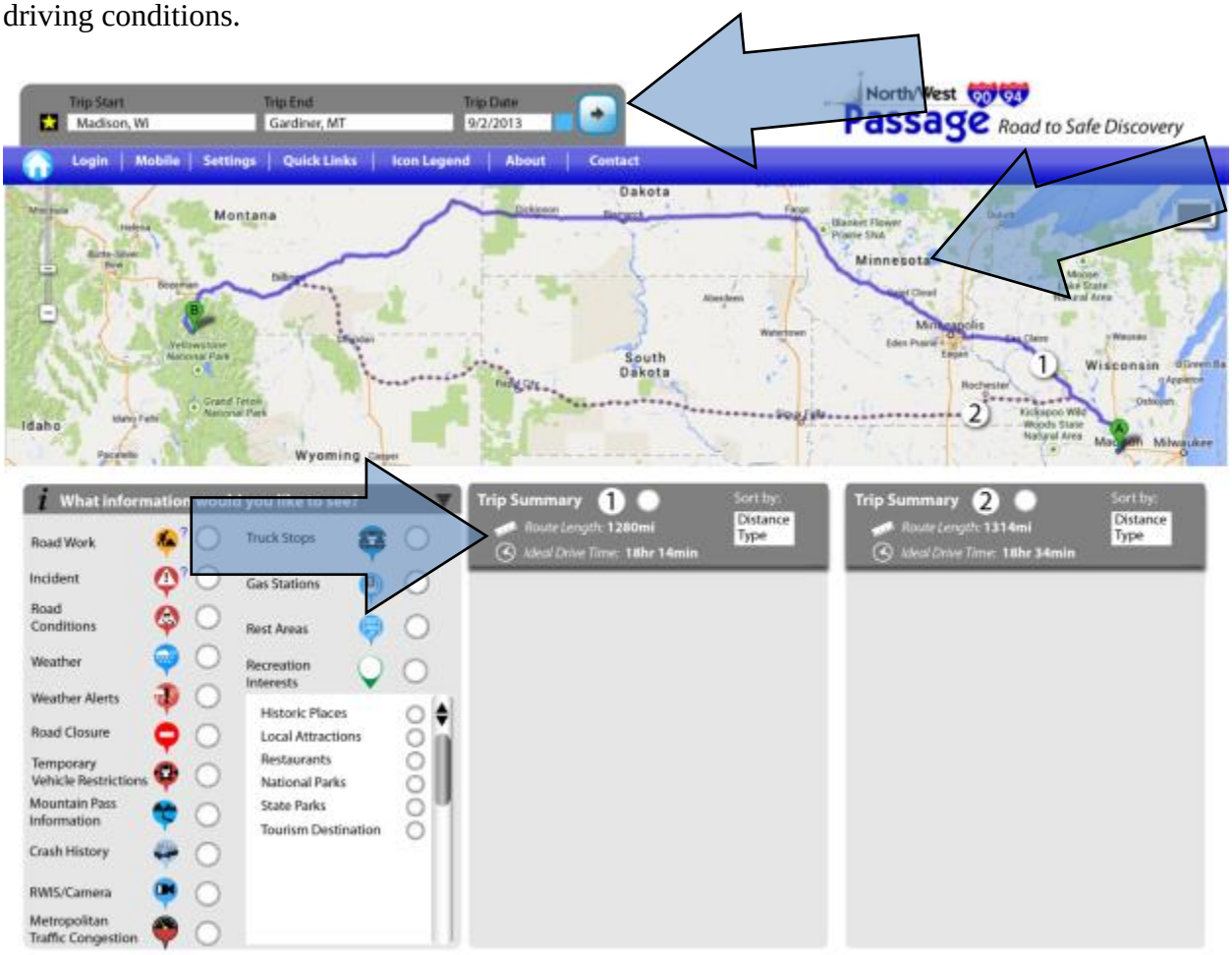




The trucker enters his origin (Madison, WI), destination (Gardiner, MT), and departure date (9/2/13).

After entering his trip information, the trucker sees the webpage display an updated map with two potential routes highlighted. Route 1 uses I-94 and passes through North Dakota and route 2 uses I-90 and passes through South Dakota and Wyoming.

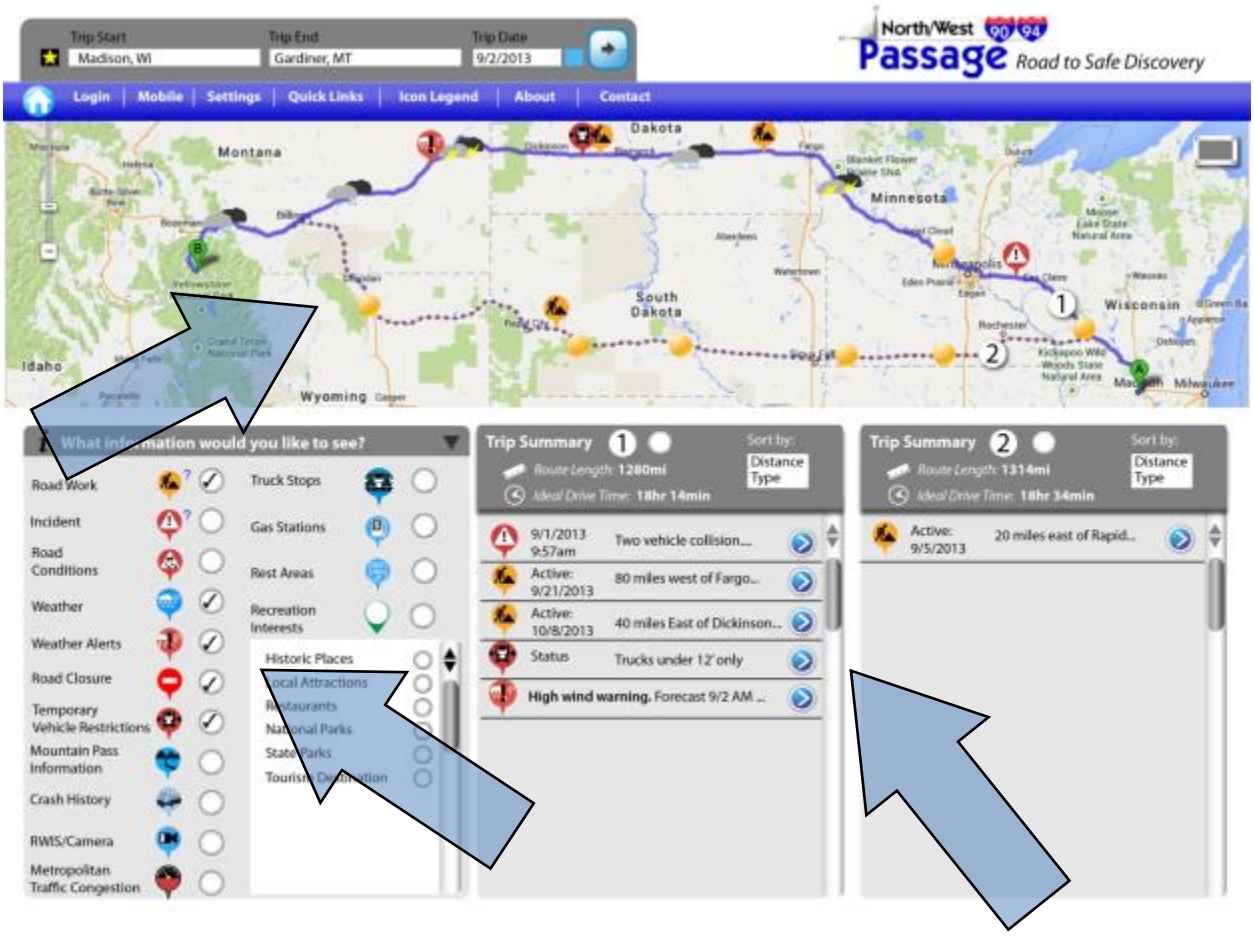
The route comparison table also updates and shows the trucker basic information about the two routes including total distance and total estimated travel time. The trucker notices that route 1 is 34 miles shorter than route 2 and is estimated to take 20 minutes less than route 2 under normal driving conditions.



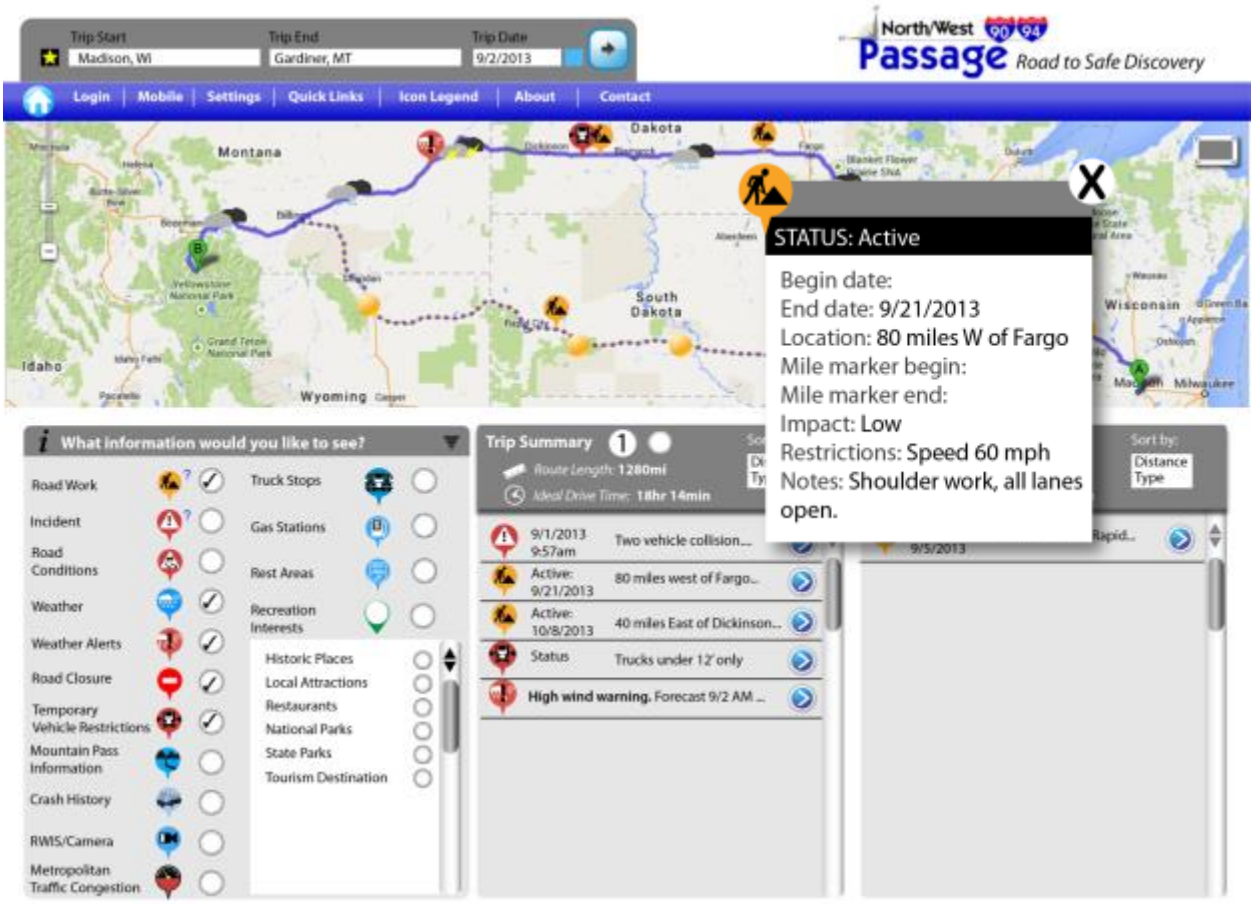
Next the trucker selects various traveler information types to view his potential routes. He selects road work, temporary truck/vehicle restrictions, road closures, and weather. The map updates to show icons for these four types of information.

The route comparison table also updates to show the traveler information for each route individually.

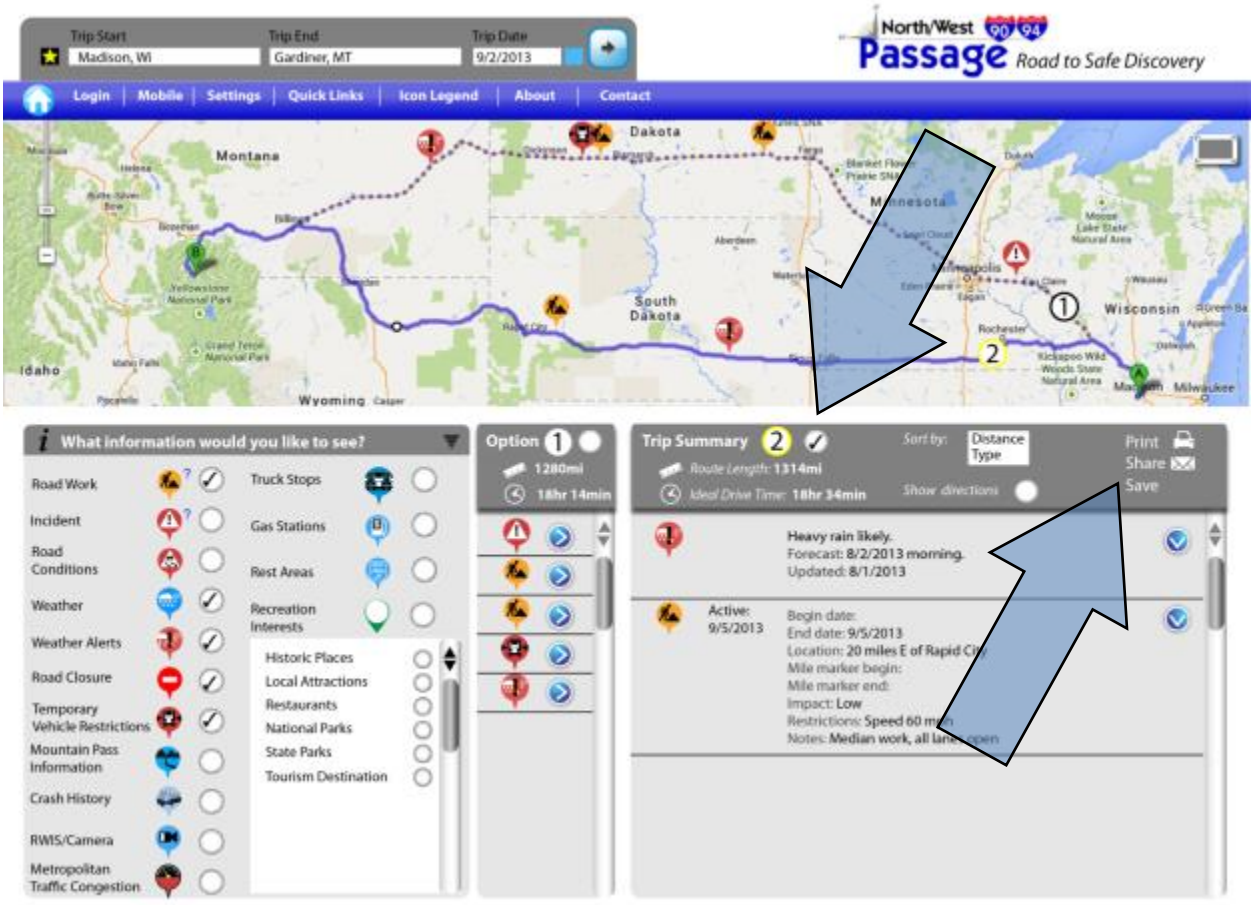
The trucker notices that route 1 currently has an incident alert, two road work zones (one with a temporary truck/vehicle restriction) and weather icons spaced out along the route. Route 2 currently shows one road work zone and similar weather icons along the route.



To get more information on the specific alerts, the trucker clicks on the icons individually. First, he clicks on the road work zone with the temporary truck/vehicle restriction. This brings up a text field showing the road work zone is active and also the project end date, location, description, and impact. This road work zone is high impact due to resurfacing that limits traffic to one lane in each direction. Next, the trucker clicks on the temporary truck/vehicle restriction associated with the construction project and sees that a width restriction limiting this zone to vehicles under 12 feet wide is in effect. The trucker also clicks on the other road work zone on I-94 and discovers that it is a low impact work zone with all lanes open, but speeds reduced to 60 mph. The last thing the trucker checks for route 1 is the weather alert in eastern Montana. This alert shows that a storm watch with high winds possible is in effect for the area until 10:00PM the following night. The trucker then decides to look closer at route 2 and selects the road work zone icon to learn more. This work zone is low impact with all lanes open and speeds reduced to 55 mph.

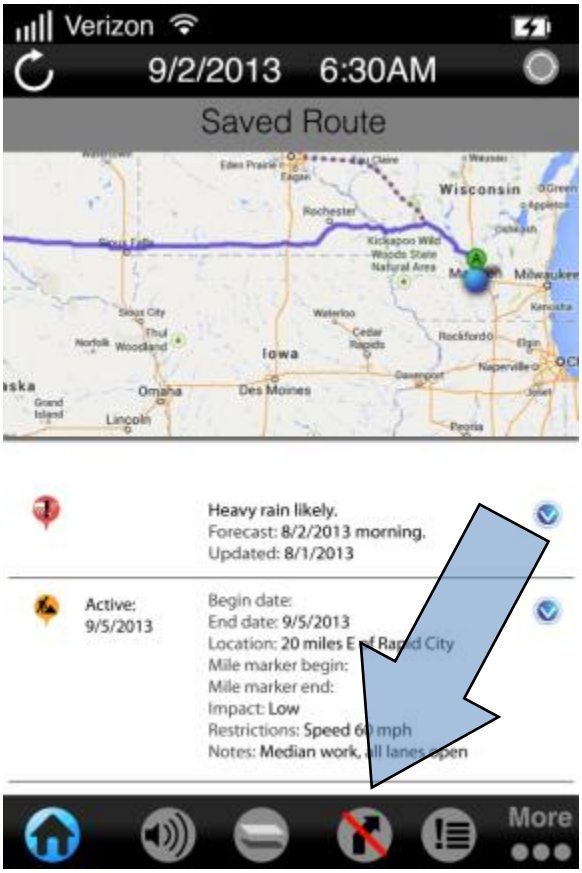


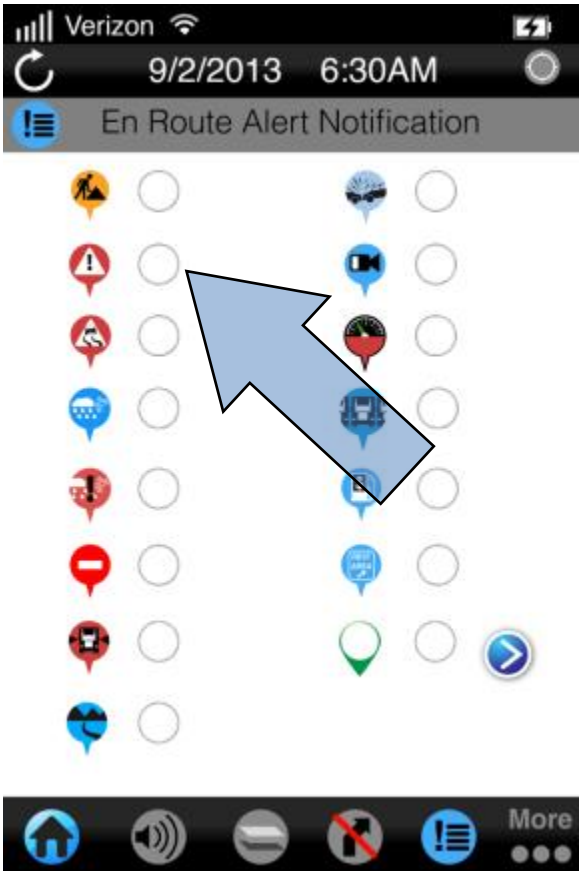
Taking these pieces of information into account the trucker decides to select route 2 (despite it being 20 minutes longer) in order to avoid the two work zones in North Dakota and the possible windy conditions in eastern Montana. The trucker selects the route 2 box on the route comparison table. The column for route 2 is then expanded and route 1's column is collapsed to provide more detail about route 2. An option to show driving directions is also provided after the trucker has made his selection of route 2. Now the trucker can save this route to his user profile or send it to himself (or others) via an email with a link. The trucker has a user profile and chooses to save this route to his profile and send a link to his dispatcher as notification of his planned route and rationale for choosing that route.



Monday (9/2/13) 6:30AM

The trucker picks up the loaded trailer and prepares for departure. The trucker uses his smartphone to access his user profile on the new *NWP Road to Safe Discovery* Advanced Traveler Information Mobile App. His route is loaded onto the browser and the driver chooses to silence the spoken turn-by-turn directions en-route, but elects to receive notification of incidents/crashes, NOAA weather alerts, and traffic congestion alerts ahead en-route. The driver departs Madison, WI.



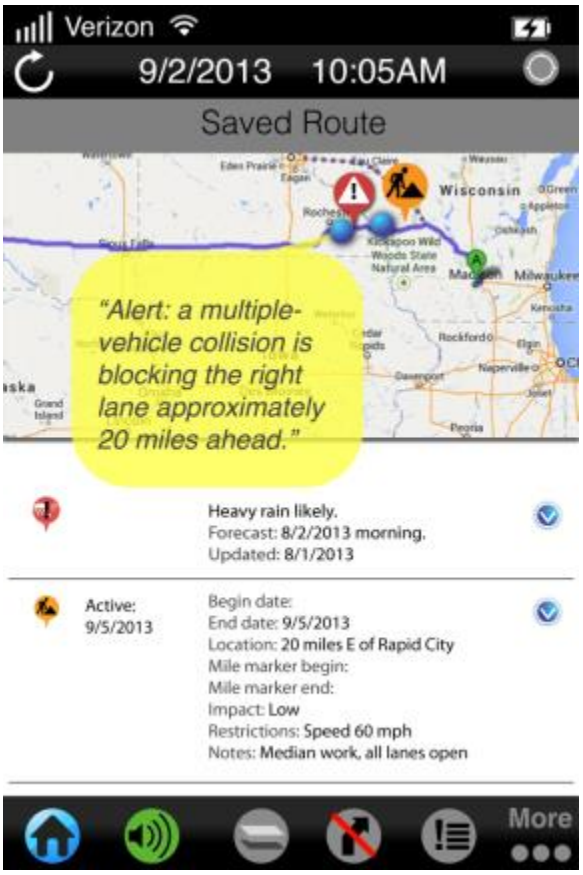


Monday (9/2/13) 10:05AM

The trucker's cell phone notifies the trucker of a crash ahead: "Alert: a multi-vehicle collision is blocking the right lane approximately 20 miles ahead". The trucker is now more alert in anticipation of the crash location and the need to change lanes soon.

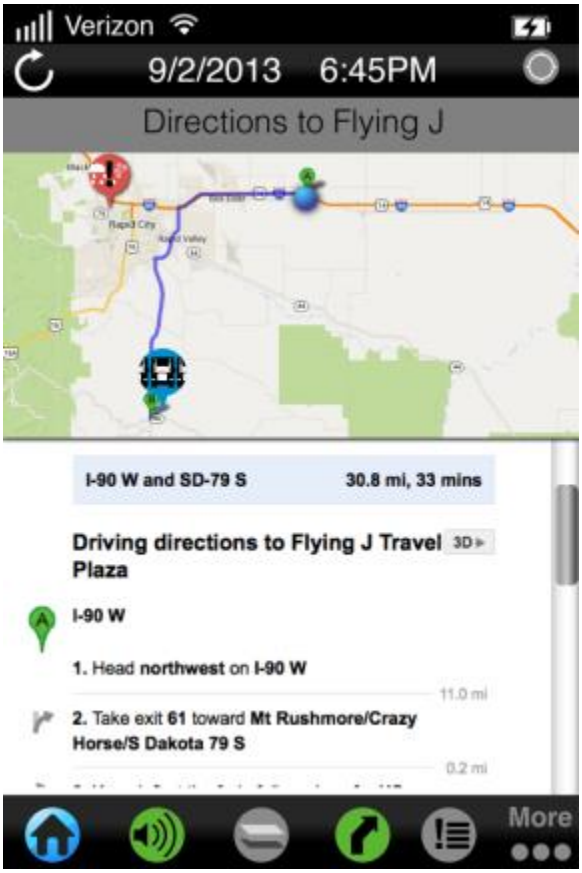
Monday (9/2/13) 10:25AM

The trucker notices traffic slowing and changes lanes to the left based on the alert he received earlier. The trucker then passes the crash location safely.



Monday (9/2/13) 6:45PM

The trucker's cell phone notifies the trucker of a NOAA weather alert: "Alert: NOAA has issued a severe storm warning with high winds approximately 100 miles ahead until 11:00PM tonight". Based on this information the trucker decides to find a place to park for the night. Using his smartphone he is able to find truck stops near his route ahead. He finds a Flying J Travel Plaza with 150 truck spaces and many amenities in Rapid City, SD approximately 15 miles away. He then selects to have turn-by-turn directions spoken to him to travel to the truck stop.

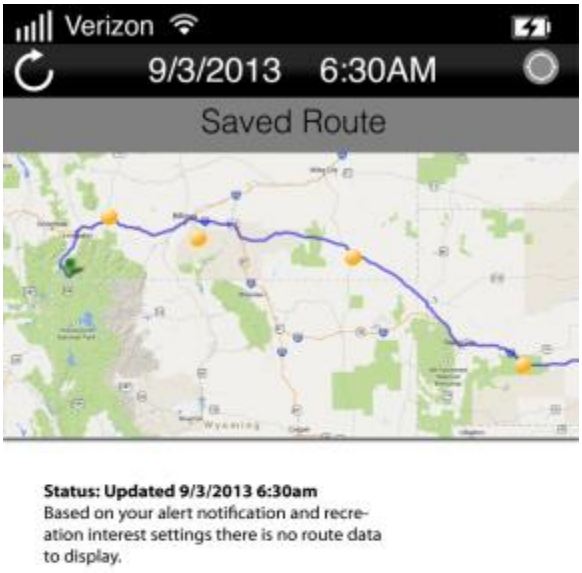


Monday (9/2/13) 7:05PM

The trucker arrives at the truck stop, takes a shower, eats at a restaurant in the facility and sleeps in his truck sleeper for the night as the storm dissipates.

Tuesday (9/3/13) 6:30AM

The trucker awakes and uses his smart phone to login to his user profile and see any updated information on his route. He sees no new information and departs from Rapid City, SD.



Tuesday (9/3/13) 3:30PM

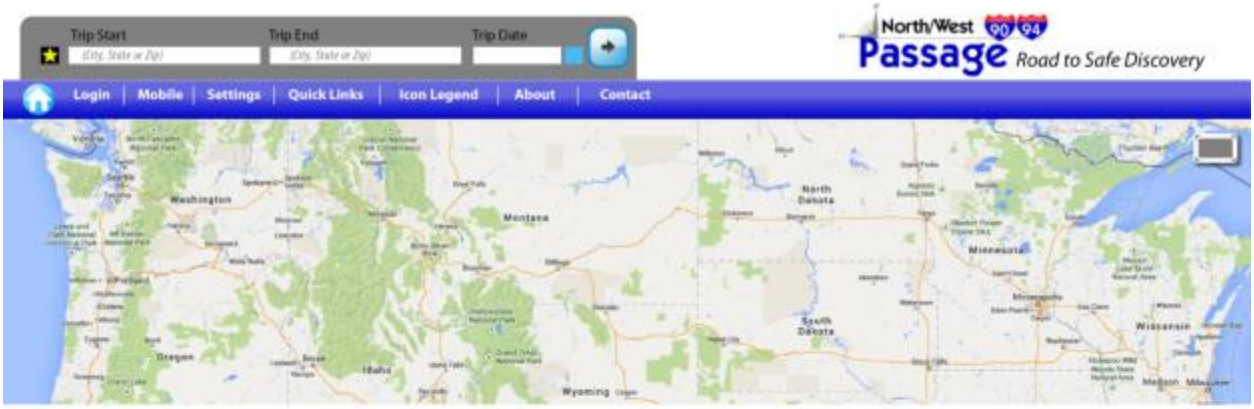
The trucker arrives in Gardiner, MT to make his delivery.

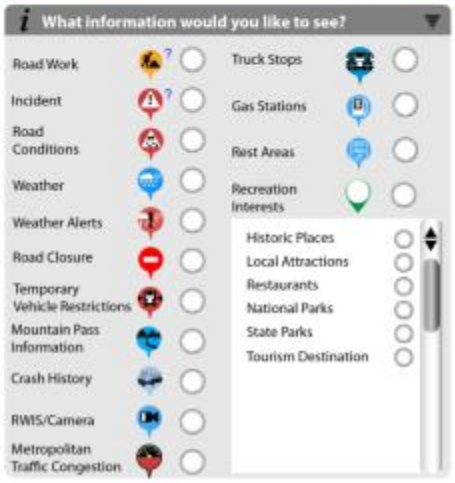
10.5 Recreational Traveler Scenario Walkthrough

Wednesday (9/4/13) 9:30AM

A man and his wife living in Bemidji, MN plan to take a trip to Mt. Rushmore, SD leaving sometime in the next few days.

The couple use their laptop to access the new *NWP Road to Safe Discovery* Advanced Traveler Information Portal.

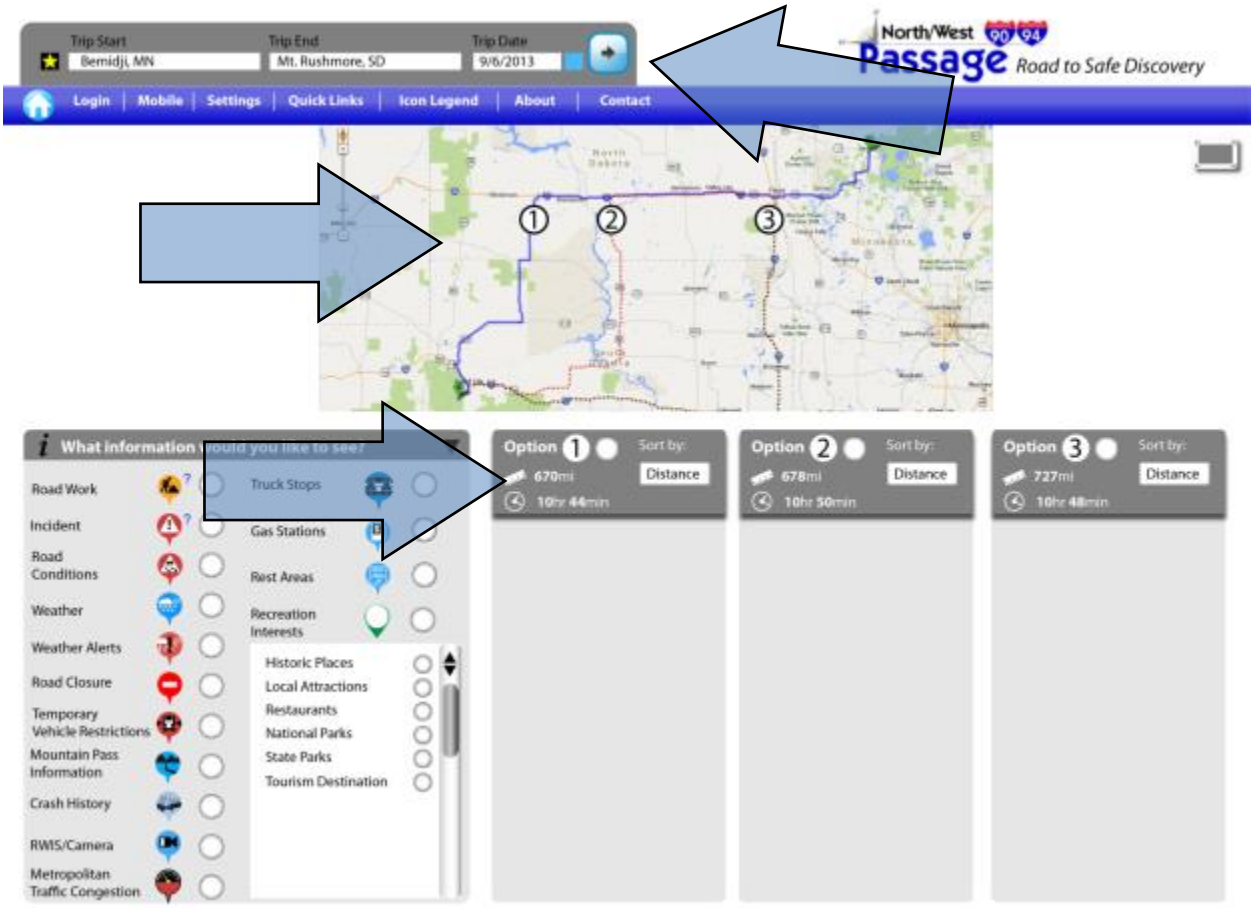




They enter their origin (Bemidji, MN), destination (Mt, Rushmore, SD), and departure date (estimated 9/6/13).

After entering their trip information, the couple sees the webpage display an updated map with three potential routes highlighted. Route 1 uses I-94 and State Highway 73, Route 2 uses I-94 and U.S. Highway 83, and Route 3 uses I-29 and I-90.

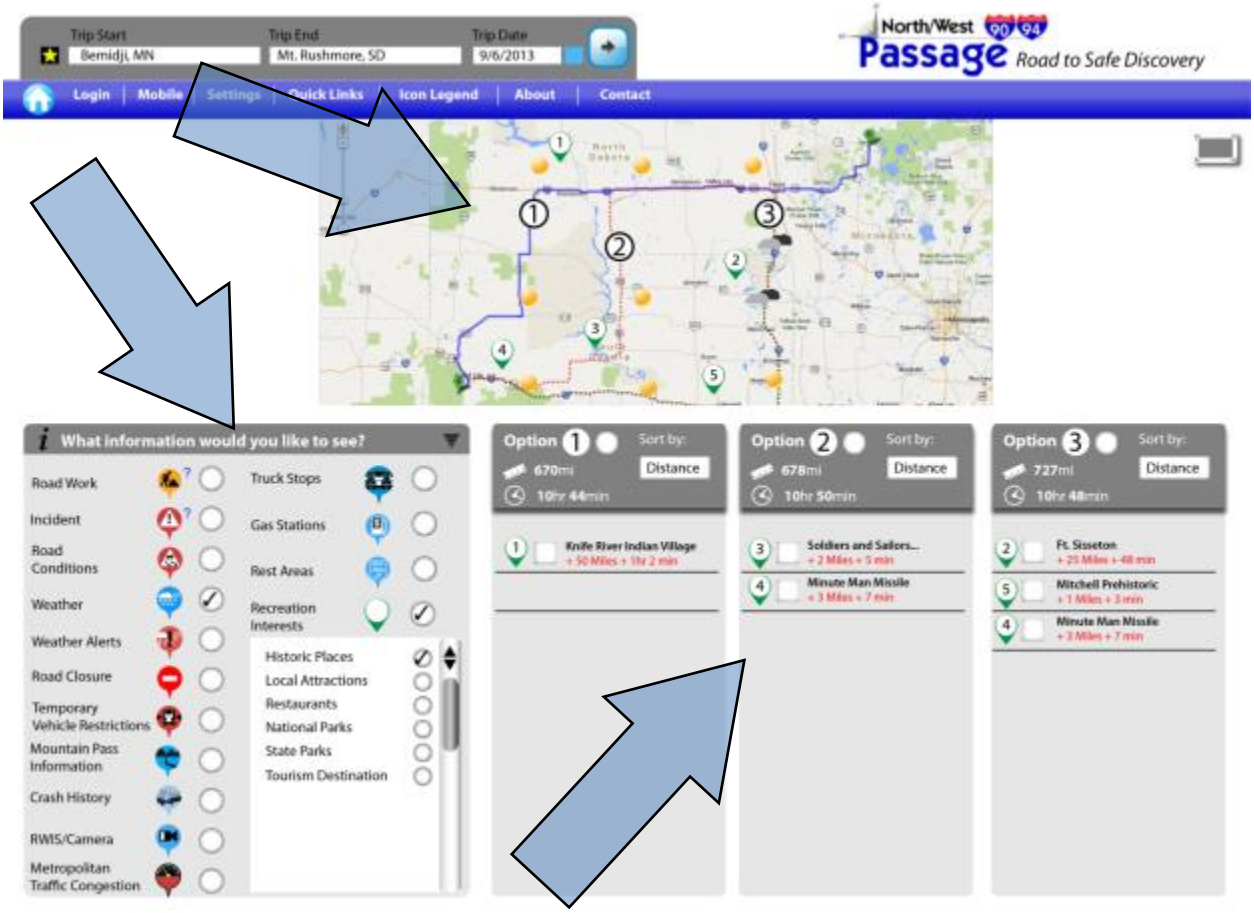
The route comparison table also updates and shows the couple basic information about the three routes including total distance and total estimated travel time. The couple notice that the expected travel time on all three routes is nearly the same.



Next the couple selects various traveler information types to view the routes. They select weather and recreation interests. The recreation interests list is displayed, and the couple selects historic places to potentially visit on their trip.

The map updates to show icons for these two types of information.

The route comparison table also updates to show the traveler information for each route individually.

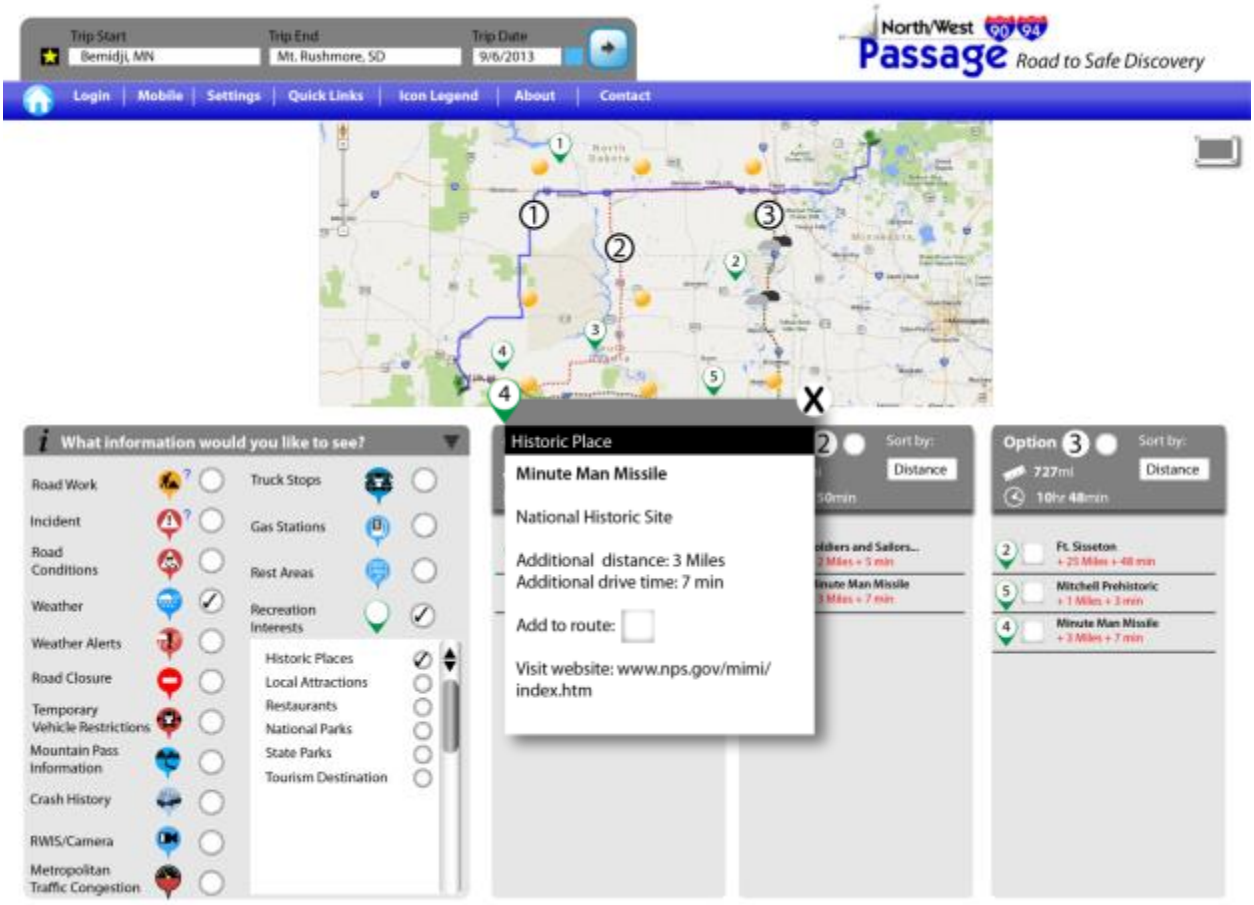


The couple notices that route 1 passes by one historic place, route 2 passes by two historic places, and route 3 passes by three historic places. Weather icons are also shown spaced out along the routes.

To get more information on the specific historic places along the routes, the couple selects each one individually. The historic place near route 1 is selected and this brings up a text field showing the name, location, additional distance and time added to route if visited, a short description of the place and a link to a website for more information. The couple sees that this is the Knife River Indian Villages Historic Site and it will add approximately 1 hour to their trip if they travel to this site.

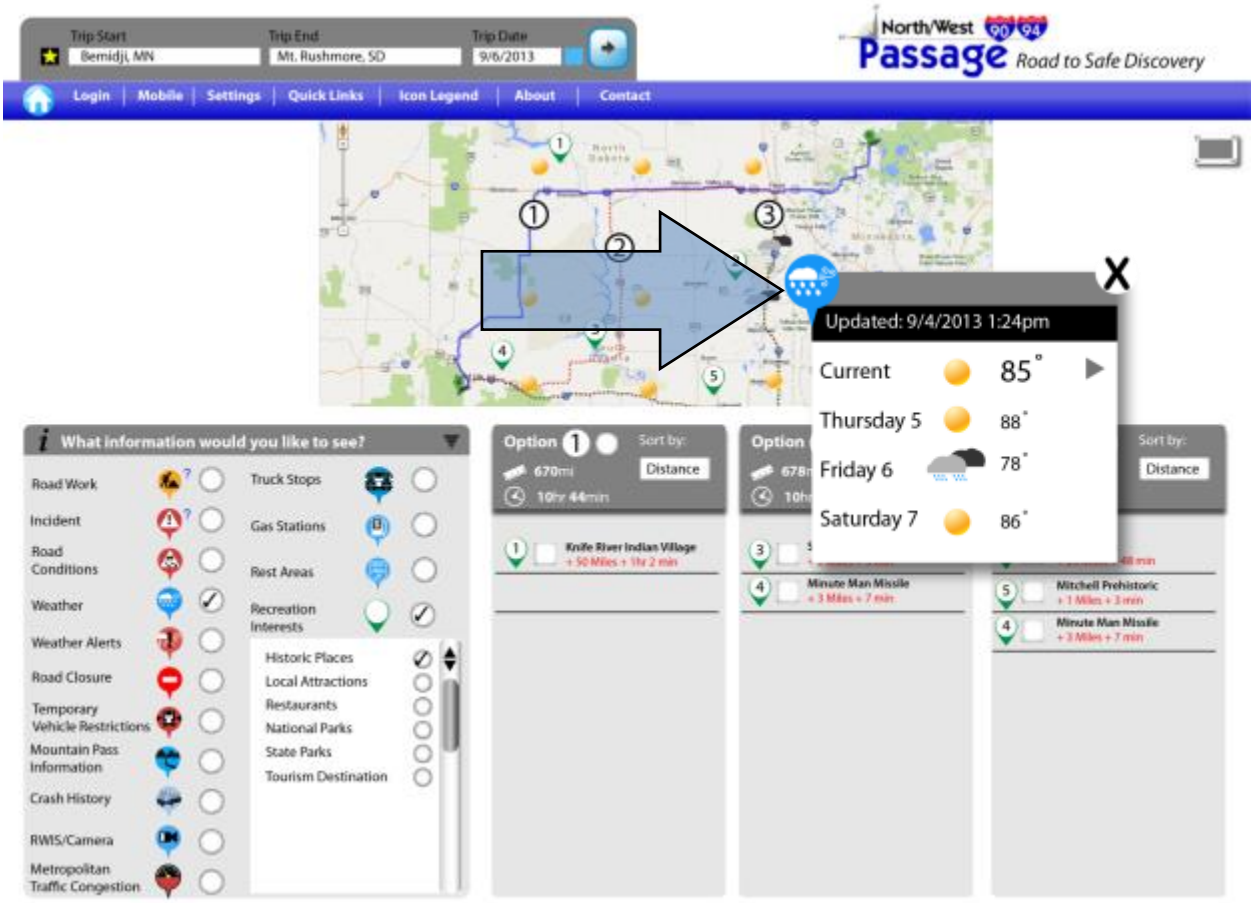
Next the couple clicks on the historic places near route 2. One is the Soldiers and Sailors World War Memorial that will only add 5 minutes to their trip and the other is the Minuteman Missile National Historic Site that will only add another 7 minutes to their travel time.

Lastly, the couple looks closer at the historic places near route 3. One is the Ft. Sisseton Historic State Park (+48 minutes), one is the Mitchell Prehistoric Indian Village site (+3 minutes) and the last one is the Minuteman Missile National Historic Site (which was also on Route 2).



The couple decides they may want to take route 3 to see the most historic places. Next they notice the weather forecast icon is showing rainy near the Ft. Sisseton Historic State Park for their departure date (9/6/13).

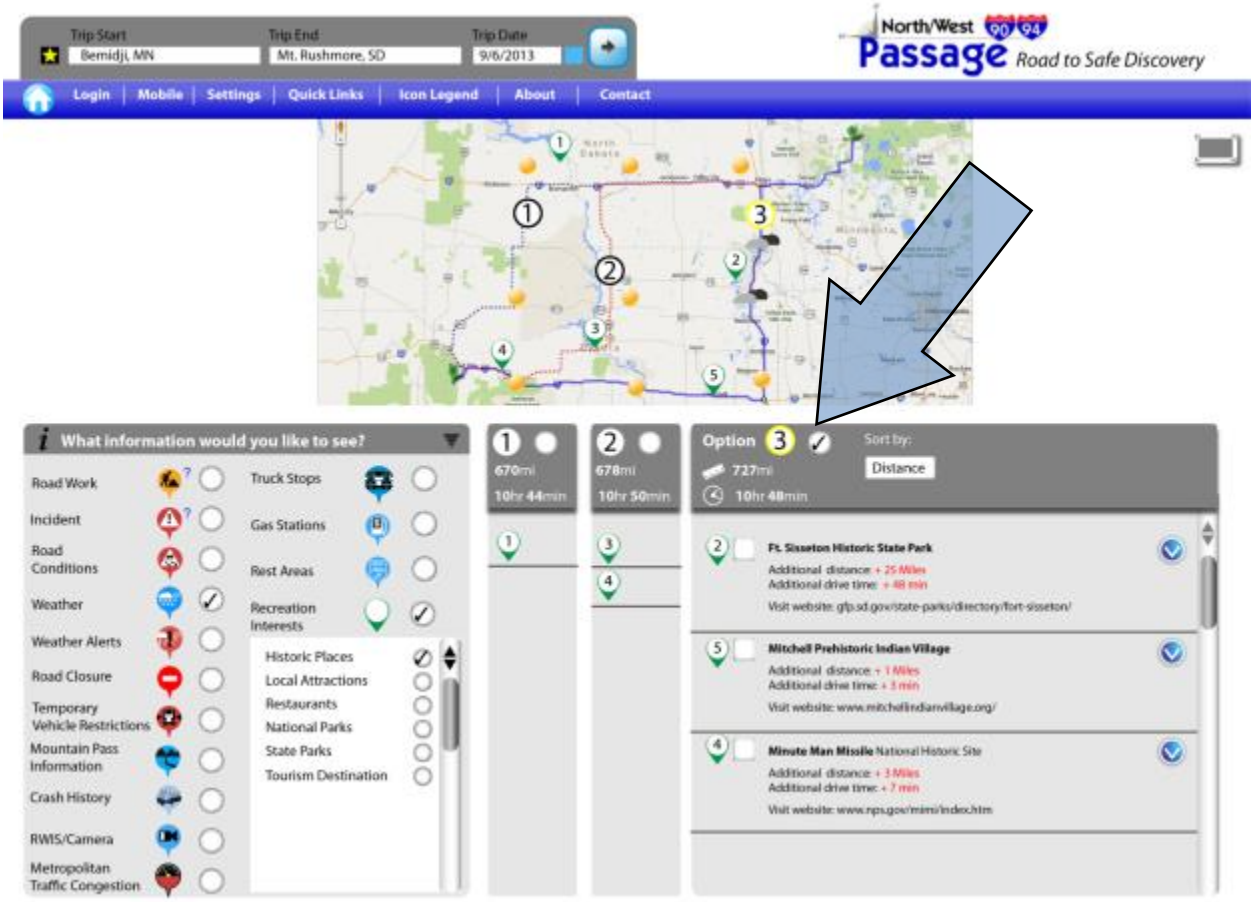
Considering the rainy forecast, they decide that they could leave Thursday instead of Friday if it meant better weather. To check this they select the weather icon near Ft. Sisseton and see that indeed Thursday's forecast is sunny.



The couple then decides to take route 3 and change their departure date to Thursday (9/5/13). They enter the new departure date and double check the weather forecast near the historic places to ensure that it looks favorable.

Then the couple checks the box for route 3 in the route comparison table.

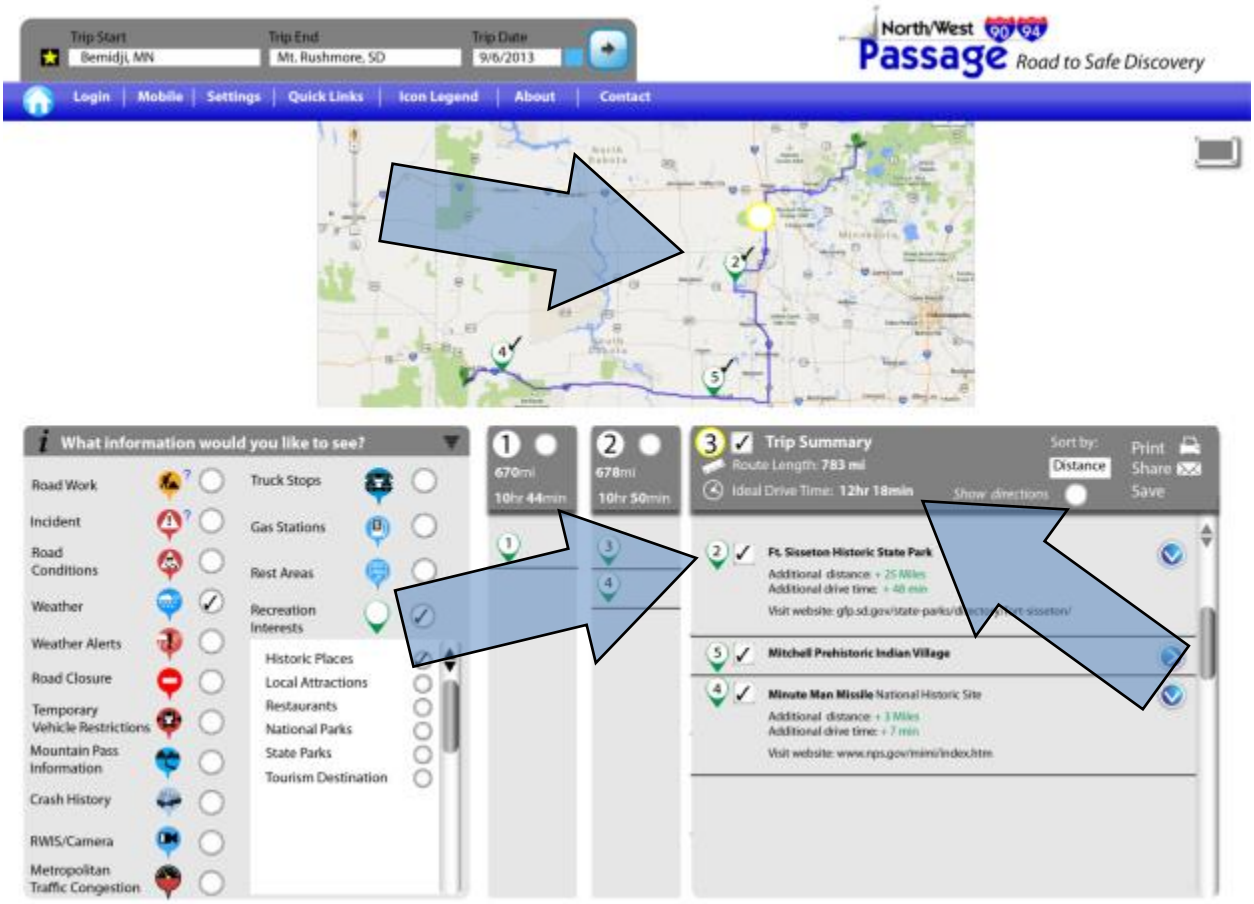
The column for route 3 is then expanded and the other route's columns are collapsed to provide more detail about route 3.



Here the couple has the option to add the individual historic places to their trip. They wish to visit all three sites and check the boxes to add them to their trip.

The map and route table are then updated to show the historic sites added to the route and the travel time estimate and total distance of travel is also updated in the route table. An option to show driving directions is also provided.

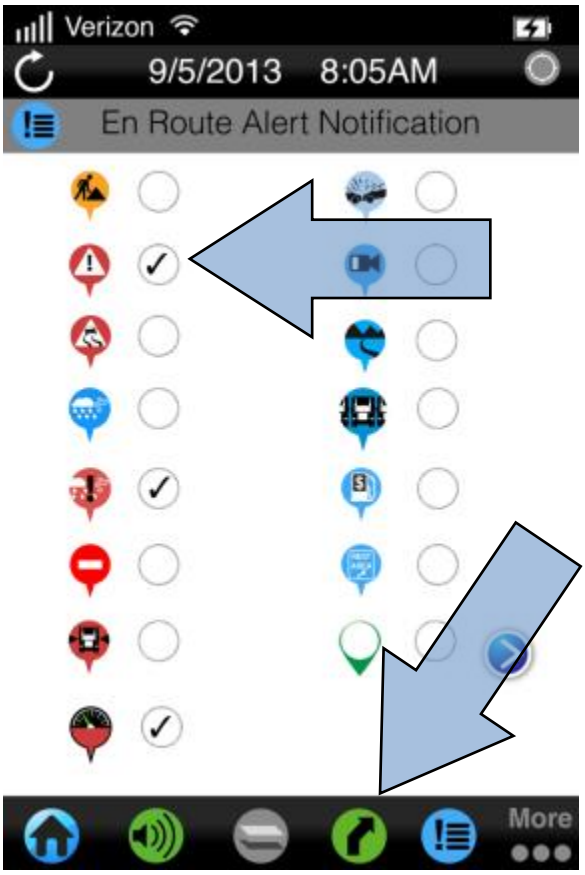
Now the couple can save this route to their user profile or send it to themselves (or others) via an email with a link. Neither of the couple has a user profile yet and they choose to send this route to themselves via email.



Thursday (9/5/13) 8:00AM

The couple prepares to depart on their trip. The man will drive initially and his wife uses her mobile tablet to access her email and open the link to their planned trip. This link launches the new *NWP Road to Safe Discovery* Advanced Traveler Information Mobile App.

The couple chooses to receive spoken turn-by-turn directions and en-route notifications for crashes/incidents, weather alerts, and traffic congestion. They depart Bemidji, MN.

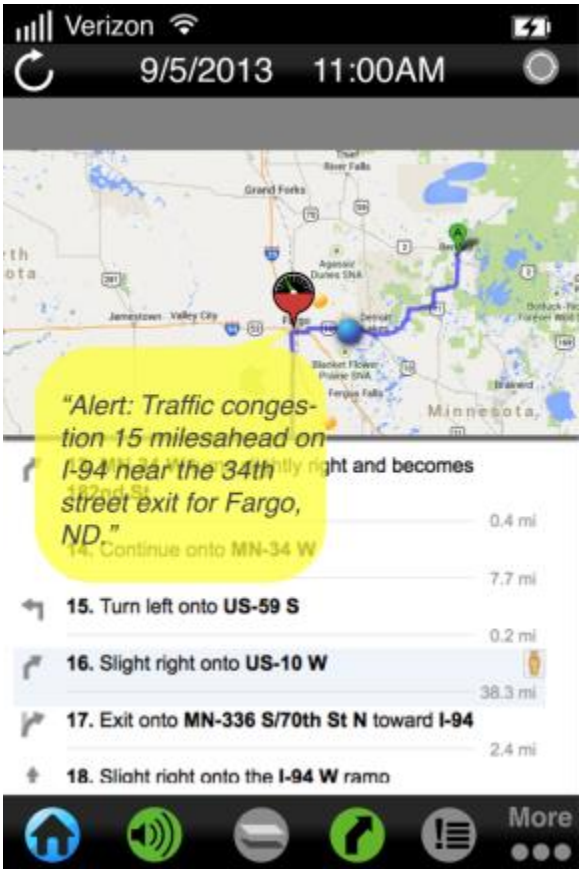


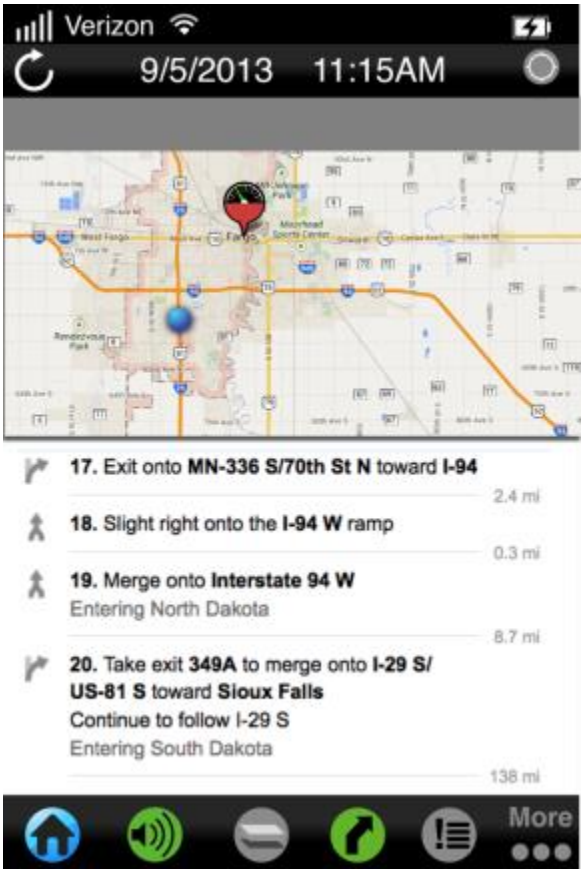
Thursday (9/5/13) 11:00AM

The couple receives an alert read aloud by the mobile tablet: "Alert: traffic congestion 15 miles ahead on I-94 near the 34th street exit for Fargo, ND".

The wife then uses the tablet to view the map and sees a way around the congested area using U.S. Highway 75 to bypass the congestion and resume their trip south on I-29.

The couple takes that route and misses the congested roadway.





Thursday (9/5/13) 1:00PM: The couple arrives at Ft. Sisseton Historic State Park and enjoys the sunny weather exploring the area and having a picnic.

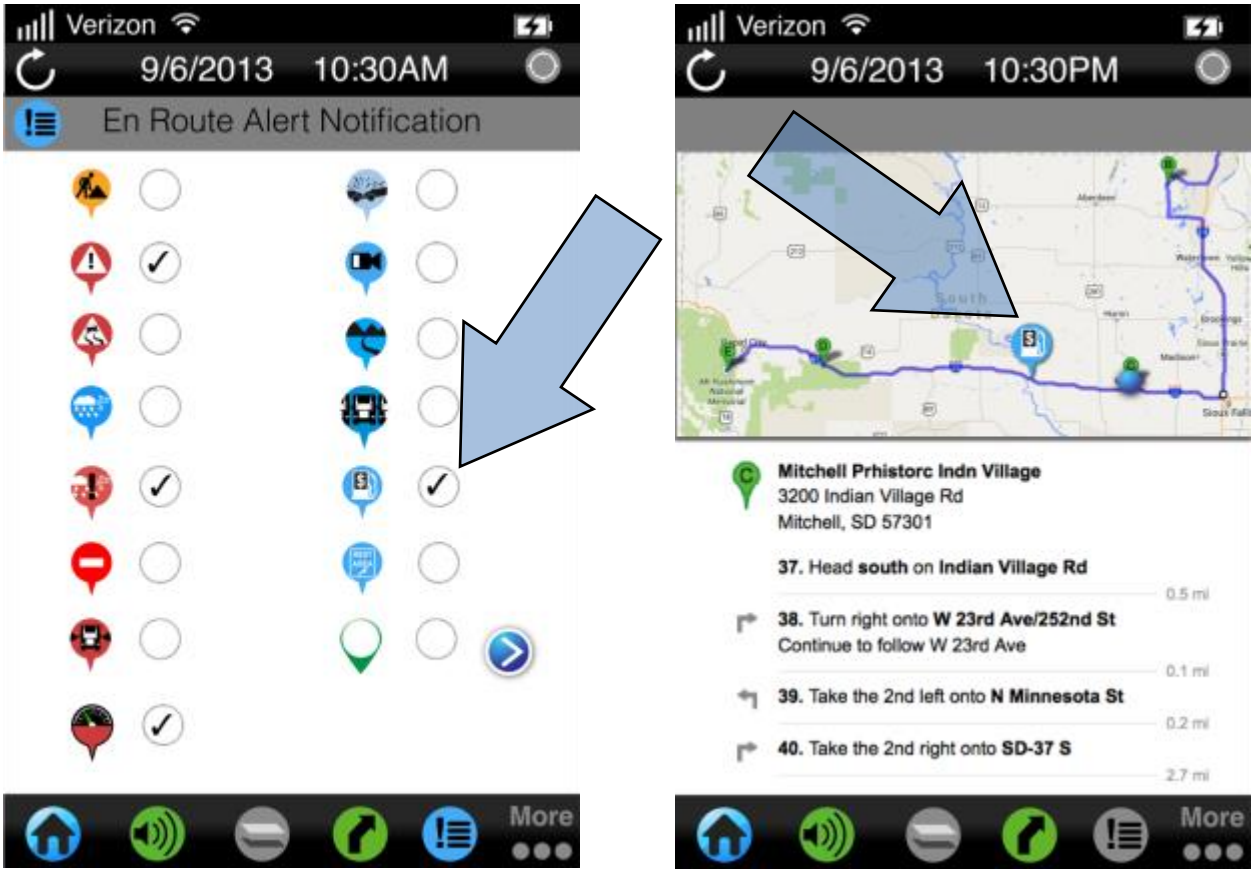
Thursday (9/5/13) 7:00PM: The couple arrives at their hotel in Sioux Falls, SD for the night.

Friday (9/6/13) 7:30AM: The couple leaves the hotel for their next historic site visit.

Friday (9/6/13) 8:30AM: The couple arrives at the Mitchell Prehistoric Indian Village and enjoys the location before departing for their next stop.

Friday (9/6/13) 10:30AM

The couple needs to purchase fuel for their vehicle soon and the wife uses the mobile tablet to find gas stations ahead near the route. She chooses the Oasis Convenience Store in Oacoma, SD and chooses to add that stop to their route. They stop there, get fuel and continue their trip.



Friday (9/6/13) 12:45PM

The couple arrives at the Minuteman Missile National Historic Site and enjoys the location before departing for their final destination (Mt. Rushmore, SD).

Friday (9/6/13) 3:30PM

The couple arrives at Mt. Rushmore and enjoys the location. When finished the couple uses their mobile tablet to find a hotel nearby and plan their trip home taking another route to visit some local attractions on their way.